TRACKING SUSTAINABLE MOBILITY IN ASIA-PACIFIC CITIES 2022

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TRACKING SUSTAINABLE MOBILITY IN ASIA-PACIFIC CITIES

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PREFACE

For many decades, cities in the Asia Pacific region have followed unsustainable patterns of transport development: worsening congestion and traffic safety, deteriorating air quality, high consumption of fossil fuels, and rising greenhouse gas emissions. Fortunately, many city governments are now developing sustainable transport strategies to target these issues and promote more sustainable modes, such as public transport and non-motorized transport. To date, however, their efforts to design effective strategies have been thwarted by their limited capacity to collect and analyze data.

The Sustainable Urban Transport Index (SUTI) was developed by ESCAP to address this gap. The SUTI is a tool to summarize, track and compare the performance of cities in sustainable urban transport and related Sustainable Development Goals (SDGs), particularly target 11.2 on access to safe, affordable, accessible and sustainable transport systems for all by 2030. The SUTI is a composite index made up of ten indicators, each measuring different aspects of sustainable urban transport. The index can be easily explained and understood by different stakeholders, which facilitates constructive dialogue. Equally importantly, the data which make up the SUTI can be collected by city officials at low cost and on a regular basis, thereby allowing them to continuously monitor their city's performance over time.

The main aim of this report is to demonstrate how SUTI can be used by policymakers to monitor progress towards sustainable urban mobility, as well as to identify those policies which will move urban transport systems towards sustainability. It contains the results of SUTI assessments conducted in 24 cities of the Asia and Pacific region between 2017 and 2021.

The development of SUTI has been a participatory process, involving a wide variety of transport stakeholders and experts. The city mobility assessment studies and impacts of COVID-19 on mobility were discussed at five regional workshops organized by ESCAP between 2017 to 2021. During the workshops, polices and strategies were also presented to improve overall sustainability, resilience and inclusiveness of urban transport systems and services. City officials shared their views on the data and how it should be collected. Meanwhile, new challenges such as COVID-19, which gripped the world during the development of the SUTI, suggest that the SUTI will continue to evolve over time as new issues emerge. The framework is flexible enough to accommodate such new issues.

Sustainability cannot be expressed in absolute terms; it is a vision that cities need to work towards. As of the end of 2022, the SUTI assessment was being applied in additional Asia-Pacific cities. It is hoped that the SUTI will become a useful tool for city policymakers and other officials to monitor the directions in which their transport systems are moving and to achieve their city's development goals.

THE SUSTAINABILITY OF URBAN MOBILITIES 1

1.1 Introduction

In 2019, urban areas in the Asia and Pacific region were home to an estimated 2.3 billion people, or 54 per cent of the world's urban population. This number is expected to increase to more than 2.8 billion by 2030, and to 3.5 billion in 2050.[1] A key dimension affecting the livability of cities is how easily and safely people can move around and get to the places they want to get to; in other words, the livability of cities is closely related to the sustainability of transport systems.

Though definitions vary, a sustainable urban mobility system is one which offers city dwellers efficient and cost-effective transport options that give safe access to key destinations and services, while minimizing pollution, greenhouse gas emissions and energy consumption (see Box 1). Sustainable urban mobility systems are also expected to enhance the economy, raise the quality of urban design, and benefit society as a whole. Urban areas which are supported by efficient and adequate transport facilities can achieve the beneficial effects of urban environments, such as agglomeration benefits[2] and increased efficiencies in manufacturing and services.[3]

However, in many Asian cities, rapid urbanization and population growth has resulted in negative externalities such as environmental pollution, solid waste generation, lack of adequate housing, and traffic congestion. In addition, urban centers are becoming more vulnerable to the effects of climate change and natural disasters. This is partly because the majority of government investments in urban transport infrastructure have targeted the road sector, which has encouraged private automobile use and brought about the rise of fuel consumption, greenhouse gas emissions and air pollution. Higher disposable incomes and falling prices of automobiles have also perpetuated the development of urban sprawl, as housing developments moved to suburbs and "new towns", adding to people's travel times and costs.

Box 1. Definitions of "sustainable mobility"

The concept of sustainable mobility is derived from the broader concept of sustainable development. The World Business Council for Sustainable Development (WBCSD) defines sustainable mobility as "the ability to meet the needs of the society to move freely, gain access, trade, communicate and establish relationships that do not sacrifice other essential ecological or human values presently or in the future."[1] Meanwhile, in 2004, the European Council of Ministers of Transport defined a sustainable transport system as one that allows basic access and development needs of individuals, various companies and society to be met safely and in a manner that is consistent with human and ecosystem health, and that promotes equity within and between successive generations.[2] Another comprehensive definition from The Energy and Resources Institute (TERI) in India is "A transport system where every individual or traveller category in a city is able to fulfil their mobility needs in a quick, affordable, reliable, safe, energy efficient, comfortable and environmentally benign manner."[3]

[1] WBCSD, 2001; [2] European Conference of Ministers of Transport, 2004; [3] TERI, 2014

Over the past two decades, sustainable urban mobility has moved from being a local issue to a national and even global issue. The 2030 Agenda for Sustainable Development,[4] adopted in 2015, provided a new impetus to efforts to address the sustainability of transport systems because of the impact of transport on several SDGs (Table 1.1). The New Urban Agenda that was adopted at the United Nations Conference on Housing and Sustainable Urban Development (Habitat III) in 2016 also emphasized the need to tackle transport as part of wider urban development challenges.[5] Furthermore, the Paris Agreement Under the United Nations Framework Convention on Climate Change (Paris Agreement) came into force on November 4, 2016. The goal of this treaty is to limit global warming to 1.5 degrees Celsius above pre-industrial levels. As transport is a major consumer of fossil fuels, the transport sector has become a target of many countries' nationally determined contributions (NDCs), actions which each country commits to in order to reduce their greenhouse gas emissions and reach the goals of the Paris Agreement.[1] Given the multifaceted nature of transport, governments face a diverse range of issues when trying to address the sustainability of their transportation systems.

Table 1.1 SDGs and targets relevant to transport

Sustainable Development Goal	Specific Targets
3. Ensure healthy lives and promote well-being for all at all ages	3.6 By 2020, halve the number of global deaths and injuries from road traffic accidents
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7.3 By 2030, double the global rate of improvement in energy efficiency (*)
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	9.1 Develop quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
11. Make cities and human settlements inclusive, safe, resilient and sustainable	11.2 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 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management (*)
12. Ensure sustainable consumption and production patterns	12.c. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances (*)
13. Take urgent action to combat climate change and its impacts	13.2 Integrate climate change measures into national policies, strategies and planning (*)

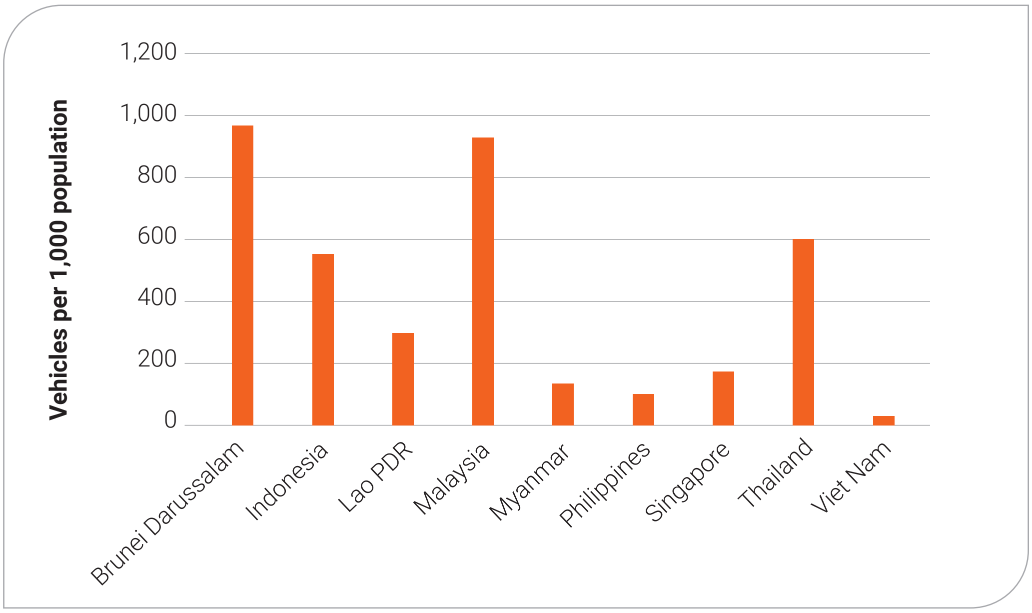
(*) These targets do not explicitly mention transport systems, but transport actions are implied or will be instrumental for their achievement.
Source: Gudmundsson & Regmi, 2017.

1.2 Key issues pertaining to sustainable mobility in Asia-Pacific cities

1.2.1 Rapid motorization and associated externalities

Compared with developed countries, per capita vehicle ownership is relatively low in many countries of the Asia Pacific region. Figure 1.1 shows the vehicle population per 1000 population in ASEAN countries. In 2019, Viet Nam for example, had only 34 vehicles per 1000 people, the Philippines had 109 vehicles per 1000 people, and Myanmar had 136 vehicles per 1000 people. However, there are outliers such as Brunei Darussalam, which had 963 vehicles per 1000 people, Malaysia with 925 vehicles per 1,000 people, and Thailand with 599 vehicles per 1000 people.[6] Increasing incomes and decreasing car prices[7] have contributed to an unprecedented growth of private vehicles in the region. Asia also accounts for almost 75 per cent of all 2-wheelers in the world, with China and India accounting for 30 per cent and 20 per cent, respectively.

Figure 1.1. Vehicles per 1000 population in ASEAN countries (2019)



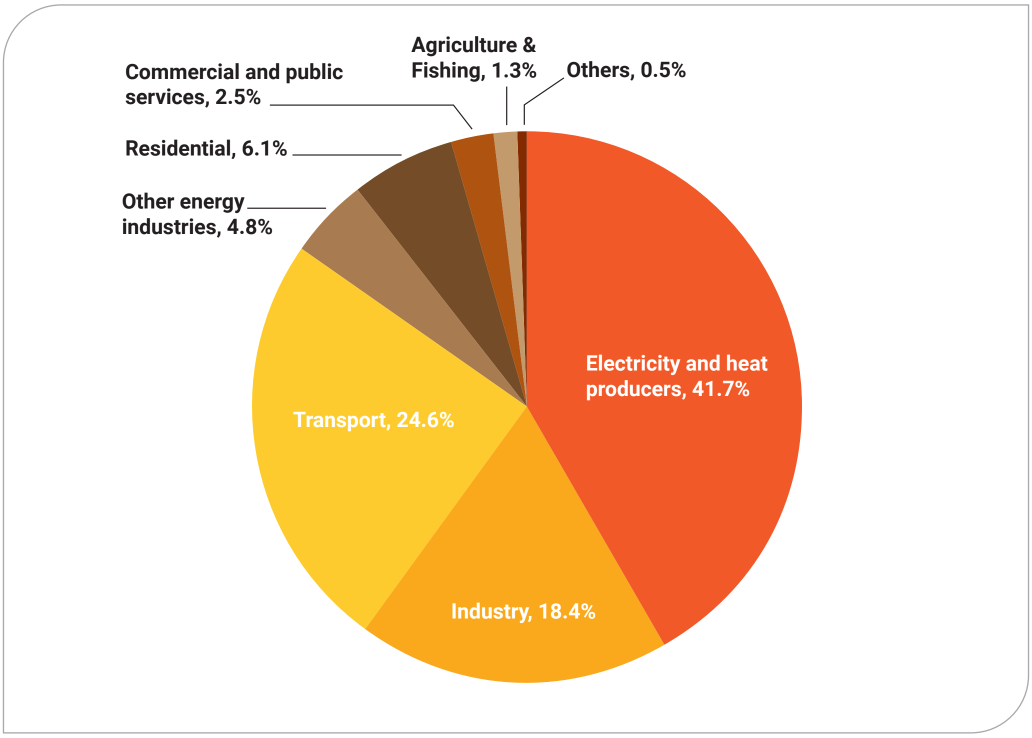
Source: ASEAN Key Figures 2020

The high rates of motorization contribute to additional externalities, including rising fuel consumption, GHG emissions and air pollution. The scale of the impact that transport has on the environment depends on local topography and how transport systems are developed, operated and maintained.[8] The most critical negative externalities are outlined below.

1.2.2 GHG emissions and climate change

The transport sector in Asia is a major contributor of greenhouse gas emissions. The transport sector accounted for 24 per cent of total CO_2 emissions in 2018 (Figure 1.2). Due to the high dependence of the transport sector on crude oil, as well as expanding human activities and transport demand, CO_2 emissions from transport are growing. Road transport is expected to account for more than 75 per cent of all carbon dioxide emissions from the transport sector by 2035 and almost 80 per cent by 2050.[9] Greenhouse gases such as CO_2, methane, N_2O, and short-lived climate pollutants such as black carbon and NOx (which forms O_3) are all by-products of vehicles.

Figure 1.2 CO_2 emissions from fuel combustion in the Asia-Pacific region, 2018



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

1.2.3 Congestion

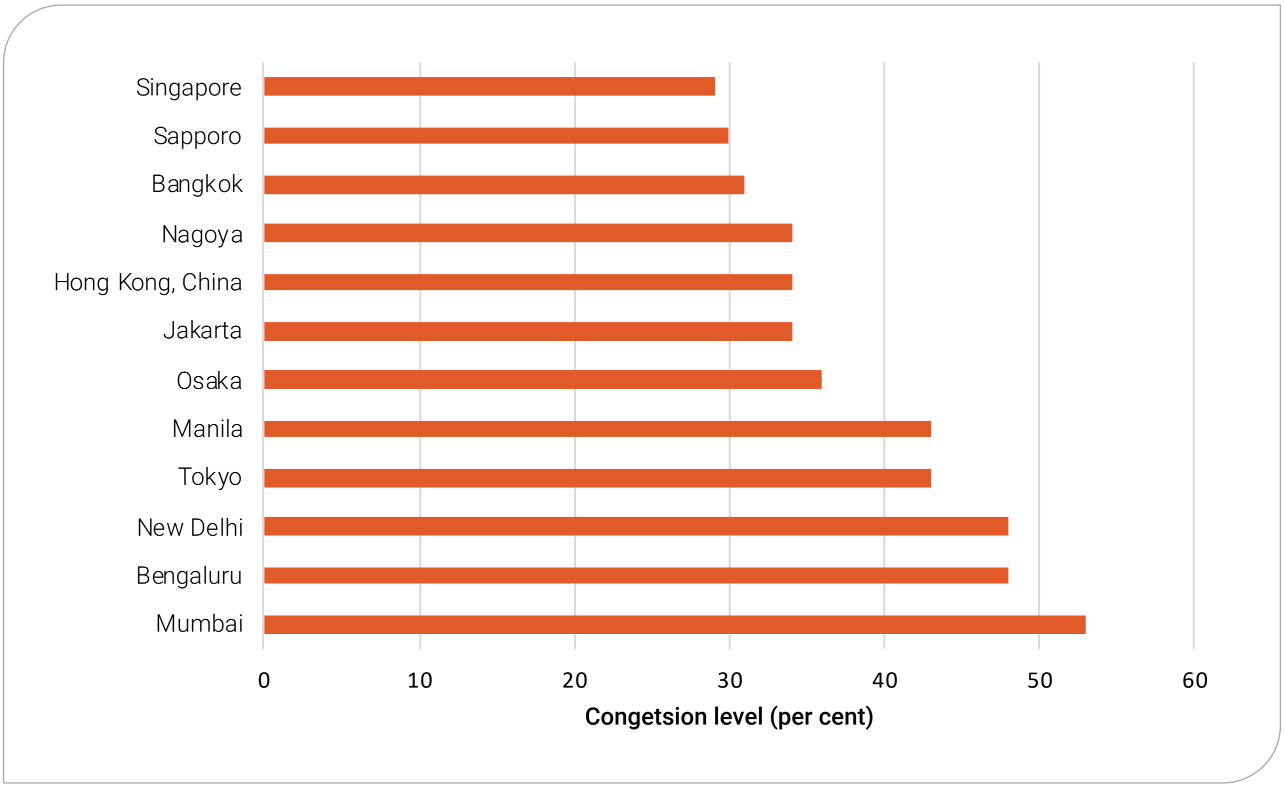
Almost every large city in Asia has their road networks choked by congestion, resulting in long commute times.[10] Rapid motorization, coupled with growing mobility demand, have led to severe congestion. In 2021, large Asian cities experienced severe traffic jams, which is defined as the increase in overall travel time compared to a free-flowing situation. Figure 1.3 shows cities such as Mumbai, Bengaluru, New Delhi, Tokyo and Manila experiencing more than 40 per cent congestion, Osaka, Jakarta, Hong Kong, China, Nagoya, Bangkok and Sapporo with more than 30 per cent congestion, and Singapore with 29 per cent congestion.

Traffic congestion leads to loss of time and productivity, loss of fuel on idling, stress and road rage, and higher exposure to vehicular emissions. Cities often react to congestion by constructing more roads and flyovers than is socially justified, using up valuable land resources in city centers. Asian economies lose an estimated 2–5 per cent of gross domestic product (GDP) every year from congestion due to lost time and higher transport costs.[11] India alone is estimated to lose $10.8 billion annually due to traffic congestion.[12]

1.2.4 Threats to energy security

In the Asia-Pacific region, the transport sector accounted for 19 per cent (852 million tons of oil equivalent) of total final energy consumption and 52 per cent of total oil consumption in 2018.[13] These trends have serious implications globally, raising concerns about national energy security for all countries. In order to reduce dependency on fossil fuels, efforts are being made to use renewables, such as biofuels, or to pair renewables with other technologies, such as electric vehicles. Despite gains in energy efficiency and the continued growth in biofuels and electric vehicles, renewable energy use is growing more slowly in the transport sector than in the heating and power sector. The share of renewable energy consumed in the transport sector in 2019 was only 3.7 per cent.[14]

Figure 1.3 Traffic congestion in Asian cities, 2021



Source: TomTom Traffic Index

1.2.5 Local air pollution

Local air pollution affects environmental quality and the health of citizens. The main pollutants arising from the transport sector are particulate matter (PM), especially PM_{10} and $PM_{2.5}$, NO_X, and hydrocarbons. The air pollution from transport is responsible for respiratory, cardiovascular and other chronic diseases. The Global Burden of Disease (GBD) attributed 3.7 million deaths globally to ambient air pollution; India alone accounted for about 0.6 million mortalities attributed to ambient air pollution in 2010.[15] Air pollution also affects vegetation, agricultural yields, visibility, and ecology. Increasing levels of NO_X also leads to ozone depletion.[16] Based on a global report by AirVisual, a Beijing-based monitoring firm, and Greenpeace, 99 out of 100 of the most polluted cities in the world in 2019 are located in Asia (IQAir, 2019). The SUTI assessments found that the annual mean PM_{10} value exceeded the 20 microgram/m^3 value set by the World Health Organization (WHO) in its guidelines, ranging from 35 micrograms/m^3 (Thimphu, Bhutan) to 193 micrograms/m^3 (Jaipur, India).[17] Other cities including Dhaka, Khulna, Ho Chi Minh City, and Surat also had very high PM_{10} values.

1.2.6 Road safety

Globally, road accidents were responsible for 1.28 million deaths in 2019 in the world[18], with the Asia-Pacific region accounting for over half of the total (714,346 fatalities). Furthermore, 96 per cent of the world's road fatalities occur in low-income and middle-income countries, even though these countries have only about half of the world's vehicles. Accidents are not just personal losses to the victims and their families, but also involve social and economic costs. An estimate carried out in 2000 suggests that the economic cost of road traffic crashes was approximately US$ 518 billion.[19] For ASEAN countries, the annual economic losses due to road accidents were estimated to be equivalent to 2.23 per cent of GDP in 2018.[20] Recent studies have found a large proportion of victims are not occupants of motor vehicles, but pedestrians or non-motorized vehicle users. Vulnerable road users accounted for about 55 per cent of road fatalities in Asia and the Pacific region.[21]

1.2.7 Poor quality of public transport services

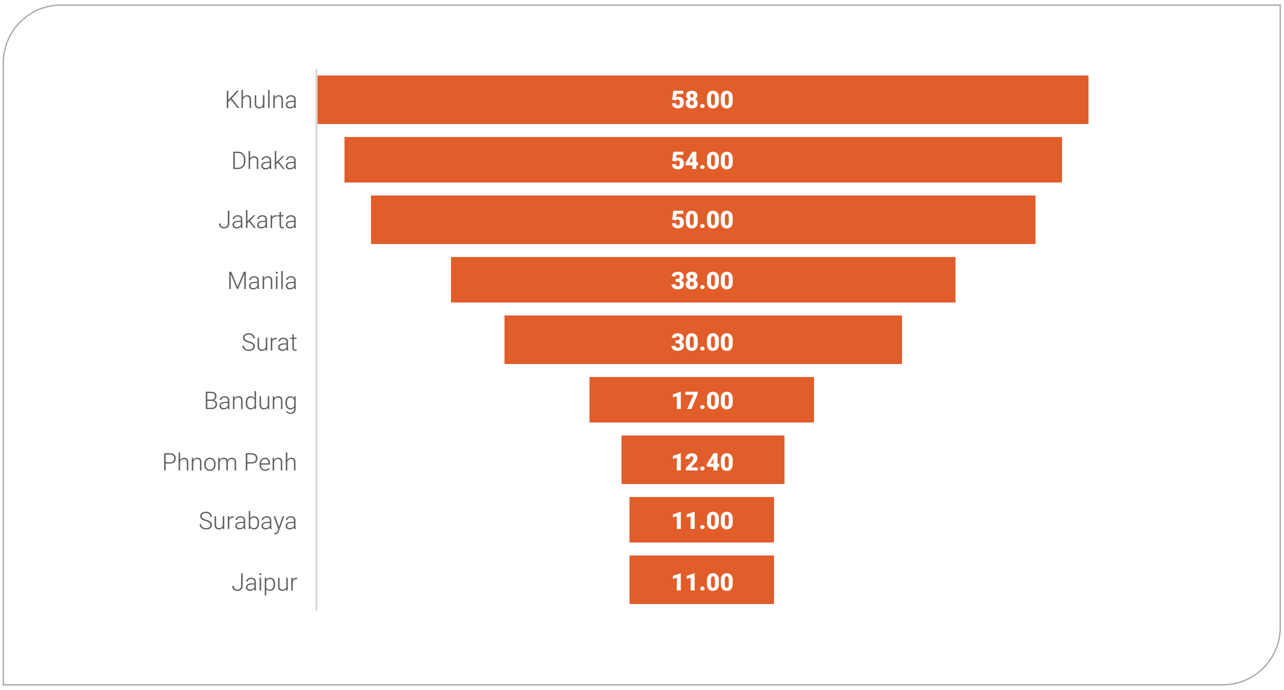
Although a few cities such as Tokyo, Singapore and Hong Kong, China, have excellent public transport systems, the quality of public transport services is relatively poor in most Asian cities. This is due to a variety of factors, including the lack of budgets for investments in large-scale transit infrastructure; competition from intermediate paratransit; inadequate and sometimes corrupt management practices; and high levels of traffic congestion which hinder the timeliness of services. In addition, both public and private urban transport systems also face many economic challenges, often because the low socioeconomic levels of passengers make it difficult to raise fares. Nonetheless, mass transit systems are now being implemented in Bangkok, Dhaka, Hanoi, Ho Chi Minh City, Greater Jakarta and many other cities in the region. For example, Bus Rapid Transit (BRT) systems now operate in more than 45 cities in Asia and are estimated to carry approximately 9.3 million passengers daily along 1,691 km of routes.[22]

1.2.8 Low priority of informal and non-motorized transport modes

Unlike developed nations, many Asian countries have informal modes in their urban transport mix, also sometimes referred to as paratransit or intermediate paratransit (IPT). In Asian cities, these include a combination of two- and three-wheeled for-hire taxis or quasi-legal mini-vans, such as autorickshaws, tuk–tuks, cycle rickshaws, jeepneys, ojeks and more recently, electric rickshaws. These modes provide flexible and cheap mobility options, but also contribute to some problems, such as congestion, pollution (due to use of outdated vehicle technologies), adulterated fuels, and competition/overlapping of routes with established public transport systems. The solution is not to ban them as a few cities have done, but to include them as an integral part of urban transport and work towards sustainable solutions for these modes, such as through replacement programs promoting e-vehicles. Paratransit modes not only provide a means of income to economically weaker groups, but also often provide transport to such groups. For example, in Indonesia, ojek or bicycle taxi operators make a livelihood by providing transport services, often to the poor. Figure 1.4 shows the share of informal transport modes in selected Asian cities. The figure shows the mode share of informal transport is as high as 58 per cent in Khulna, 54 per cent in Dhaka, and 50 per cent in Jakarta.

Figure 1.5 shows the mode share of active mobility and public transport in selected Asian cities. Though walking and other non-motorized transport (NMT) modes were common in Asian cities in the past, over the years their shares have declined and their popularity has decreased. Lack of adequate NMT infrastructure is a prominent reason behind this decline. Asian cities commonly have unsafe road crossings and broken and uneven pavements, which are often encroached upon by street vendors and parked vehicles. Footpaths are now making way for wider roads, and cyclists are pushed out of roads by fast moving traffic. For example, bicycle lanes built in the 1960s and 1970s are being encroached to make way for vehicles. In some cases, it has become difficult for NMT users to commute between places due to urban sprawl, so an increasing number of people have moved to private motorized vehicles.[23]

Figure 1.4 Mode share of informal transport in Asian cities (per cent)



Source: ESCAP Mobility Assessment Reports

Figure 1.5 Mode share of active and public transport (per cent) for selected cities

Source: ESCAP Mobility Assessment Reports

1.2.9 Exclusionary transport systems

Designing a transport system that is inclusive of all groups in society remains a challenge for urban planners. Current planning processes in Asian cities sometimes do not take this into account, so vulnerable groups such as women, the elderly, the poor and weaker sections of society are often affected by inequity of access. This can be measured by differences in modal shares, travel times, ease and costs that arise between various groups such as men and women; rich and poor; people with different kinds of disabilities; and private vehicle owners and those using other modes. The monopoly of private vehicles penalizes those who walk, cycle or ride buses, which are the predominant transport modes of the poor. They are left with fewer travel choices than others and also suffer disadvantages in employability as they are not able to travel as fast or as far as others. Women also face security issues and discrimination on public modes, in addition to other barriers to access which put them at risk of being socially excluded from transport.

1.2.10 Lack of integrated and inclusive planning

Integrated urban planning ensures that the planning efforts and plans are in alignment with a city's economic, social and environmental goals. However, the urban and transport sectors of many cities in the Asia and Pacific region are characterized by a fragmented policy environment. There are often multiple agencies involved in planning, operating and managing transport systems, and the responsibilities and liabilities are not clearly demarcated. Implementing city-wide strategies such as multimodal integration and transit-oriented development becomes difficult, and efforts remain isolated or end up as stand-alone projects. Other barriers are the lack of legal/administrative powers to implement policies, financial restrictions, lack of political or public acceptance, weak enforcement, and institutional coordination issues. Sometimes the lack of participation of different stakeholders in policy-making processes leads to conflict and resistance. For example, in many Asian cities, the drivers of three-wheelers and conventional taxis make up a strong force against transport reforms that prioritize more efficient vehicles with lower emissions. As in other regions of the world such as Latin America, meaningful transport reform is difficult to achieve unless these groups are represented as stakeholders.

1.3 Need for a framework to assess the sustainability of urban transport systems

The above discussion may sketch a grim picture of challenges facing the urban transport systems in many Asian cities. However, more and more policymakers recognise that transport externalities can be contained without affecting economic growth. This requires the integration of sustainable and low carbon transport policies in their development strategies. Experiences from other cities show that ssuccessful urban transport systems build on a thorough assessment of past, current and future performance of the urban transport system. It is therefore important to establish a baseline against which progress can be measured.

The factors affecting the sustainability of transport systems have both qualitative and quantitative dimensions, and the various groups or sections of a society value these factors differently. Sustainable transport systems typically encompass a myriad of policies and planning issues, including integrated land use planning, the promotion of public transport and non-motorized transport modes, inter-modality, last-mile connectivity, safety, accessibility, affordability and satisfaction of users from different communities, logistics, mobility management and use of technology. Addressing all of these issues is a Herculean task, one which often appears to be beyond the capacity of municipal governments.

In this regard, it is important that the governance framework used to discuss issues around sustainability is transparent and credible. Towards this end, ESCAP developed the Sustainable Urban Transport Index (SUTI) with the objective of giving city officials a tool with which to benchmark changes in key areas. To make it easy to use, SUTI was limited to ten indicators, though there is scope for adding more dimensions in the future. In fact, issues such as gender equity, use of renewable energy in public transport, and assessment of impacts of COVID-19 on mobility have already been considered as additional elements. The next chapter provides a general introduction to the SUTI and explains the thinking behind the indicators.

1 UN HABITAT, 2019
2 Brülhart, 2009
3 Henderson, 2000
4 United Nations, 2015
5 United Nations, 2016
6 ASEAN Key Figures 2020, Lim, 2019, The Economic Times, 2018, UN HABITAT, 2010
7 ERIA Research Project Report 2012-29, 2013
8 ESCAP, 2020
9 ESCAP, 2020
10 CAI-Asia
11 ADB, n.d.
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22 https://brtdata.org/location/asia (accessed 28 September 2022)
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SUSTAINABLE URBAN TRANSPORT INDEX (SUTI) 2

2.1 Rationale for SUTI

In October 2016, the United Nations Secretary General's High-Level Advisory Group on Sustainable Transport submitted its report "Mobilizing Sustainable Transport for Development", which called for comprehensive monitoring and evaluation methodologies for sustainable transport by national and local governments.[24] As there was no comprehensive system to measure sustainable transport across cities in the Asia-Pacific region, ESCAP initiated work on the Sustainable Urban Transport Index, or SUTI, in 2016. The aim was to develop an index to summarize, track, and compare the performance and progress of cities in their efforts to make their urban transport systems more sustainable. The index was developed with a view to balance the measurement of what is necessary to support sustainable transport planning on the one hand, and the scope of data likely to be available at the city level. In other words, the key objectives when developing the SUTI were to:

- Reflect the SDGs and other sustainability concerns which are relevant for urban transport;
- Limit the number of indicators to the most essential ones;
- Avoid indicators that are overly demanding or sophisticated to collect; and
- Adopt an index calculation method that is as simple, transparent, and unbiased as possible.

The development of SUTI followed a systematic methodology and involved a comprehensive review process and consultation with countries and cities. This section presents the basic conceptual framework and thinking behind the SUTI. Further details of the methodology used can be found in ESCAP (2017), Gudmundsson and Regmi (2017), and Regmi (2020).

2.2 Conceptual framework

A conceptual framework was needed in order to design the scope of the index and to select appropriate indicators. Fundamental concepts to be incorporated in the framework were sustainable development, transport, Sustainable Development Goals (SDGs) and their targets, and how they connect in the urban context. The conceptual framework for SUTI (Table 2.1) was based on:

- The main services and impacts that urban transport provides with regards to the three dimensions of sustainability (economic, social and environmental);
- Generic strategies applied to pursue sustainability for urban transport (based on the sustainable mobility paradigm of "Avoid, Shift and Improve");
- SDG targets related to urban transport.[25]

Table 2.1 Summary of conceptual framework for SUTI and elements

Fundamental aspects	Framework elements
Sustainable Development Dimensions	Economic dimension impacts
	Social dimension impacts
	Environmental dimension impacts
Sustainable Mobility Paradigm	Avoid strategy
	Shift strategy
	Improve strategy
SDG Targets Relevant for Urban Transport	3.6 Deaths and injuries from road traffic
	9.1 Quality, reliable, sustainable, resilient infrastructure
	11.2 Access to safe, affordable, accessible and sustainable transport systems for all
	11.6 Adverse environmental impact including air quality 11.7 Universal access to safe, inclusive and accessible, green and public spaces
	7.3 Improvement of energy efficiency 13.2 Integrate climate change measures

Source: ESCAP, 2017

An extensive literature review was conducted to identify indicators being used in the sustainable transport literature. Then these indicators were organized in groups to form consolidated indicator sets based on the framework criteria, as proposed by Castillo and Pitfield (2010).

a) Criteria aiming to maximize the relevance of indicators for the concept of sustainable transport.
This was done by scoring indicators for each dimension of the SUTI framework.
b) Criteria aiming to maximize the methodological quality of the indicators, namely:

- definition and concept available in existing reports;
- has been applied in practice in several cities;
- data regularly available or readily produced;
- clear interpretation possible;
- scale to normalize indicator for index can be easily defined; and
- relevant and actionable for cities.

It was deemed important to include two types of indicators: those which tracked the transport system itself ("System"), and those which tracked the impacts of transport systems ("Social", "Economic" and "Environmental" impacts). The final set of indicators is given in Table 2.2.

Table 2.2 Identification of indicators

No.	Indicators	Dimensions	Strategies	SGD Targets
1	Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	System (Environmental/Social)	Shift	11.2
2	Modal share of active and public transport in commuting	System (Environmental/Social)	Shift	11.2
3	Convenient access to public transport service	Social	Shift	11.2
4	Public transport quality and reliability	Social	Shift	11.2
5	Traffic fatalities per 100,000 inhabitants	Social	Improve	3.6
6	Affordability – travel costs as part of income	Economic/Social	Improve	11.2
7	Operational costs of the public transport system	Economic	Shift/Improve	9.1
8	Investment in public transportation systems	Economic	Shift	11.2, 9.1
9	Air quality (PM10)	Environmental	Avoid/Shift/ Improve	11.6
10	Greenhouse gas emissions from transport	Environmental	Avoid/Shift/ Improve	7.3, 13.6

Source: ESCAP, 2017

2.3 Process of developing SUTI

ESCAP provided support through data collection guidance, consultations, and financial support for the collection of data and preparation of a mobility assessment report for each city. An expert group meeting held in Kathmandu, Nepal, in September 2016, discussed the concept of SUTI, and a regional meeting held in Jakarta, Indonesia, in March 2017 finalized and adopted the SUTI. Pilot application of SUTI was conducted in four cities: Colombo, Greater Jakarta, Hanoi and Kathmandu in 2017, and the results were reviewed and discussed at a workshop in Colombo in 2017.

The fifth session of the Committee on Transport held in November 2018 endorsed the SUTI and recommended its wider application throughout the region. Based on the Phase-1 application study in 2018 and the recommendations of the experts, the indicators were improved and revised slightly at a workshop held in Dhaka in 2018. The new SUTI framework has been in use since 2019.

The five regional workshops organized to review the SUTI mobility assessments in cities were: Capacity Building Workshop on Sustainable Urban Transport Index, 30-31 October 2017, Colombo, Sri Lanka; Capacity Building Workshop on Sustainable Mobility and Sustainable Urban Transport Index, 12-13 September 2018, Dhaka, Bangladesh; Regional Capacity Building Workshop on Sustainable Mobility and Sustainable Urban Transport Index, 28–29 October 2019, Hanoi, Viet Nam; Virtual Regional Workshop on Urban Mobility and Impacts of COVID-19 on Mobility, 25-26 November 2020, Bangkok, Thailand and Regional Workshop on Sustainable, Inclusive and Resilient Urban Passenger Transport: Preparing for Post-Pandemic Mobility in Asia, 28-29 October 2021, Bangkok, Thailand.

2.4 Final set of indicators – definitions, database, and construction

Based on the above process, the ten SUTI indicators were selected. Their measurement units, normalization ranges and methodologies for calculation are described in Table 2.3.

Table 2.3 SUTI Indicators and how they are measured

S. No.	Indicators	Measurement units	Weights	Range		Key Data	General Methodology
				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	Qualitative review and scoring of the city's most recent master plan on a scale 1–16.	This indicator must be produced by undertaking a document review of the city's most recent transport plan and scoring it with a set of criteria defined for this indicator. This review involves designating an expert or a small expert team to read and score the plan according to the criteria. Time, manpower and independence, should be secured for this process

Table 2.3 SUTI Indicators and how they are measured (cont.)

S. No.	Indicators	Measurement units	Weights	Range		Key Data	General Methodology
				MIN	MAX		
2	Modal share of active and public transport in commuting	Trips/ mode share	0.1	10	90	Based on travel survey and other sources.	This 'modal share' indicator is of interest in many cities, but definitions vary, and data can be a problem. In case no data exist, or existing ones are outdated (e.g. 10 years old or more) the city will need to derive new data on transport volumes (trips) per mode. This may involve conducting some form of travel survey or using other methods.
3	Convenient access to public transport service	Percentage of population	0.1	20	100	Share of urban population living within 500 metres of frequent public transport service.	This indicator requires the combination of data for the density and frequency of the public transport (PT) service network, and data for the number of citizens living in 500 m buffer zones of main nodes in the network. Requires effort to derive data both for PT frequency and population inside the buffer zones.
4	Public transport quality and reliability	Percentage satisfied	0.1	30	95	Satisfaction survey among public transport users.	This indicator is based on measuring the satisfaction of Public Transport users with the quality and reliability of public transport services. Any existing survey results may need to be updated, adjusted or re-interpreted to match the format defined. If no survey exists, a basic survey has to be prepared and conducted within a short time.

Table 2.3 SUTI Indicators and how they are measured (cont.)

S. No.	Indicators	Measurement units	Weights	Range MIN	Range MAX	Key Data	General Methodology
5	Traffic fatalities per 100,000 inhabitants	Number of fatalities	0.1	10		Police reported fatalities.	Traffic fatality numbers are available with City Traffic Police. That is probably the most comprehensive secondary data source. Data can also be found in official statistics or hospital records.
6	Affordability – travel costs as a part of income	Per cent of income	0.1	35	3.5	Costs of public transport fare card or monthly tickets divided by the income of low-income groups.	The indicator needs data on costs for a monthly pass or similar for the PT network as well as statistical data on income for segments of the population. It is cost of a monthly network-wide public transport ticket covering all main modes in the city, compared to the mean monthly income for the poorest quartile of the population of the city.
7	Operational costs of the public transport system	Cost recovery ratio	0.1	22	100	Fare box ratio (operating cost recovery via fares).	This indicator needs to be derived from the accounting reports and data of public transport companies. It will likely be necessary for some cities to consult public PT authority or company or individual operators to request the data.
8	Investment in public transportation systems	Percentage of total investment	0.1	0	50	Share of all transport investments that are allocated to public transport (5-year average).	The indicator uses data from public accounts of investments and spending (5-year data to be averaged). Data that is required: investments in bus procurement, investments in bus infrastructure development (workshops, depots, terminals, bus stops), investments in ITS

Table 2.3 SUTI Indicators and how they are measured (cont.)

S. No.	Indicators	Measurement units	Weights	Range MIN	Range MAX	Key Data	General Methodology
							(PIS, vehicle monitoring, fare collection equipment and infrastructure), investments in bicycle and pedestrian infrastructure and investment in infrastructure for public transport.
9	Air quality (PM_{10})	μg/m³	0.1	150	10	Annual mean concentration of PM_{10}.	The indicator is population weighted air quality monitoring data reported to national agency or WHO. May need conversion from $PM_{2.5}$ data if PM_{10} not available.
10	Greenhouse gas emissions from transport	CO_2 Eq. Tons/capita/ year	0.1	2.75	0	Tons of transport GHG emissions per inhabitant per year.	The indicator is a calculated value of emissions of GHG (CO_2 equivalent) from transport in a city per year, divided by the population.

Note: Updated SUTI data range for indicator 5 (min changed to 10 from 35) and 7 (max changed to 100 from 175)

Indicators on different scales are normalized and the performance of each indicator is compared on a scale of 1-100. Only one data value per indicator is needed to calculate SUTI. The index is calculated as the geometric mean of the 10 normalized indicators equally weighted using the following formula:

Where,

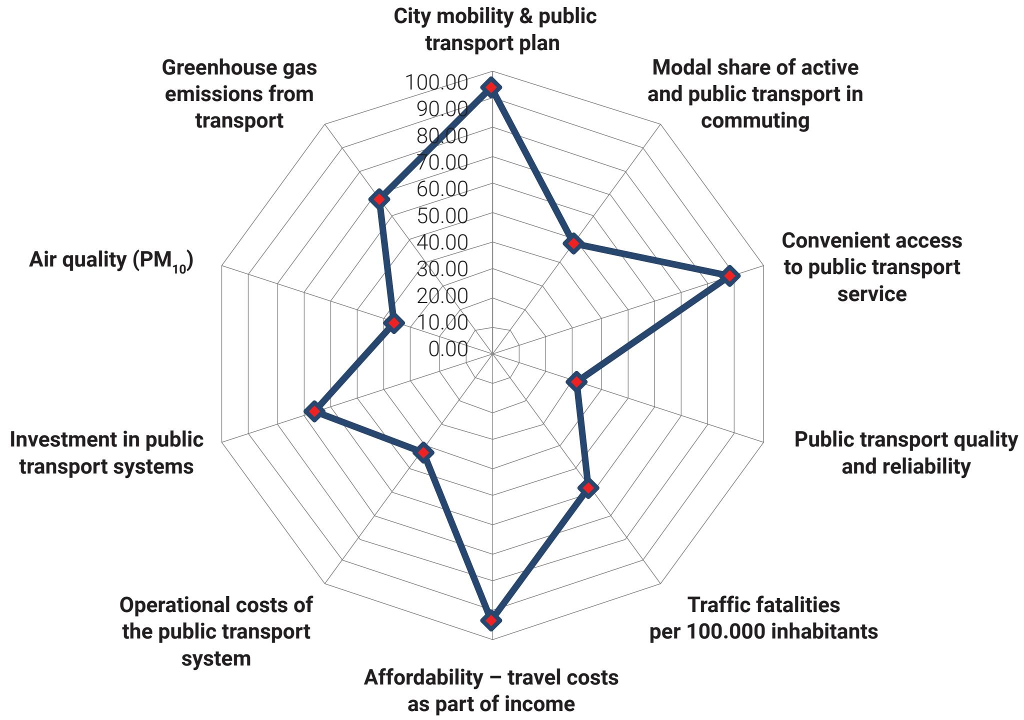
$$\sqrt[10]{i1*i2*i3...i10}$$

i1…i10 are the indicators.

To ensure that cities collect data for the same ten indicators, a set of guidelines were prepared. These guidelines describe the data collection process, including filling in the SUTI data sheet for the individual indicators and advice on how the city can review the results (details of the guidelines can be found at https://www.unescap.org/sites/default/files/SUTI%20Data%20Collection%20Guideline.pdf). A SUTI data sheet was also developed as a Microsoft Excel worksheet to support data collection and analysis (available from https://www.unescap.org/sites/default/files/SUTI-Data-Analysis-Sheet-Update-2018.xlsx). Entering data for all ten indicators will calculate the SUTI, generate a spider diagram and provide a snapshot of the city's overall state of urban transport, as well as the performance of each indicator (Figure 2.1). The visual display of each indicator allows policymakers to easily comprehend the urban transport system. A high value (near the outer circle of the diagram) indicates good results, while indicators with low values (near the centre of the circle) need more attention. The guidelines also outline the way forward towards assessment and comparison among cities. Repeating the exercise at regular intervals (for example, every two years) would allow a city to track performance over time. The assessment of urban mobility using the SUTI indicators and the derivation of the index among similar cities with standardized data collection methodologies can also enable a comparison between cities, though caution is needed with such a comparison given the different characteristics of each city.

In addition to the ten indicators of the framework, data on social inclusion in public transport and the use of renewable energy in transport (including number of low emission vehicles and electric vehicles) have started to be collected and analysed. In addition, the impacts of COVID-19 on mobility were incorporated into the guidelines. The SUTI reports prepared in 2020 and 2021 and ESCAP publications[26] also covered the impacts of COVID-19 on mobility and the resilience of urban mobility.

Figure 2.1 Sample SUTI Spider Chart for easy visualization



2.5 City Mobility Assessment Using SUTI

ESCAP member countries were invited to submit proposals from candidate cities to join the mobility assessment exercise using SUTI. The final list of cities as of 2021 is:

1. Bandung, Indonesia
2. Bangkok, Thailand
3. Bhopal, India
4. Colombo, Sri Lanka
5. Dhaka, Bangladesh
6. Hanoi, Viet Nam
7. Ho Chi Minh City, Viet Nam
8. Islamabad and Rawalpindi, Pakistan
9. Jaipur, India
10. Greater Jakarta, Indonesia
11. Kathmandu, Nepal
12. Khulna, Bangladesh
13. Mashhad, Islamic Republic of Iran
14. Metro Manila, the Philippines
15. Palembang, Indonesia
16. Pekanbaru, Indonesia
17. Phnom Penh, Cambodia
18. Surabaya, Indonesia
19. Surat, India
20. Suva, Fiji
21. Tehran, Islamic Republic of Iran
22. Thimphu, Bhutan
23. Ulaanbaatar, Mongolia
24. Yangon, Myanmar

Table 2.4 presents an overview of the basic characteristics of these 24 cities.

Table 2.4 Basic Characteristics of the 24 Cities

S. No.	City	Study area	City Size (km^2)	Population (million)	Average population density (in p/km^2)	Modal share of active and public transport (per cent)
1	**Bandung**	Bandung Municipality	167	2.95	17,631	19.34
2	**Bangkok**	Bangkok Metropolitan Area	1,568	15	3,690	37.6
3	**Bhopal**	Bhopal Development Authority	813	2.02	2,482	70
4	**Colombo**	Western Region	3,684	6.2l	1,774	75.45
5	**Dhaka**	Dhaka Metropolitan Area	302	14.4	47,537	60
6	**Hanoi**	Hanoi City	3,325	7.7	2,306	10.65
7	**Ho Chi Minh City**	Ho Chi Minh City	2,095	8.61	4,109	28.52
8	**Islamabad and Rawalpindi**	Islamabad and Rawalpindi	906 and 5,286	2 and 2.09	2,211 and 8,100	51.2
9	**Jaipur**	Jaipur City	467	3.4	7,281	41
10	**Greater Jakarta**	Greater Jakarta	6,767	30.1	4,448	27.19

Table 2.4 Basic Characteristics of the 24 Cities (cont.)

S. No.	City	Study area	City Size (km^2)	Population (million)	Average population density (in p/km^2)	Modal share of active and public transport (per cent)
11	**Kathmandu**	Kathmandu Valley	722	2.8	3,878	69.77
12	**Khulna**	Khulna Development Authority (KDA) including Khulna City Corporation (KCC)	45	1.5	33,333	37.7
13	**Mashhad**	Mashhad	351	3.1	9,000	55
14	**Metro Manila**	Manila	39	13.48	47,899	63.65
15	**Palembang**	Palembang Municipality	401	1.6	4,151	32.66
16	**Pekanbaru**	Pekanbaru City	632	1.1	1,808	35
17	**Phnom Penh**	Phnom Penh	679	2.19	3,224	1.55
18	**Surabaya**	Surabaya City	350	3.06	8,742	13.95
19	**Surat**	Surat Municipal Corporation	326	5.21	15,956	29
20	**Suva**	Greater Suva Area	2,048	0.28	136	56
21	**Tehran**	Tehran Municipality	750	9.1	12100	37.4
22	**Thimphu**	Thimphu	26	0.115	4,389	36.8
23	**Ulaanbaatar**	Ulaanbaatar City	3,789	1.49	393	55.7
24	**Yangon**	Yangon City	948	5.1	5,346	52.9

Source: City mobility assessment reports

The next chapter presents a profile of each city, including a brief description of their urban mobility systems and a summary of their SUTI mobility assessment. While describing the current state of each SUTI indicator in a city, the range of minimum and maximum values in Table 2.3 are used as reference and the corresponding indicator value in a city is described as bad, moderate or good.

[24] UN-HLAG, 2016
[25] Further information about the development of SUTI can be found in ESCAP (2017) and Gudmundsson & Regmi, 2017.
[26] ESCAP (2021) and Schwanen and Regmi (2022)

3 SUSTAINABILITY ASSESSMENT OF URBAN MOBILITY IN ASIA-PACIFIC CITIES

3.1 Bandung (2018)

3.1.1 City Overview

Bandung is the third most populous city in Indonesia after Jakarta and Surabaya, with a total of 2.95 million residents (2017) spread over an area of 168 km². The city is the capital of Java Province. With its rich natural setting, it is a major resort city, attracting a large number of tourists. Over the years, Bandung has also grown to become an important economic centre, with manufacturing, textiles and apparel, pharmaceuticals, food processing, financial services and entertainment services emerging as key economic activities in the city.

Transport in Bandung is mostly road-based. The length of the road network in Bandung is 1,236 km (2016). In the city, most of the network (94 per cent) is in 'good' condition, while the rest is in 'medium' condition. The core city is dense and characterised by mixed land use. Radial roads emerge from the centre, connecting surrounding areas with the core. In 2016, the Bandung Municipality had a stock of around 1,716,698 vehicles, 73 per cent (1,251,080) of which were motorcycles. The rate of growth of private vehicles is 10 per cent per annum, and if this trend continues, the congestion levels on the streets are likely to become unmanageable.

The primary means of public transportation is the minibus, or Angkot. These basic and cheap minibus services are privately operated and serve multiple routes throughout the city. Public transport services are also provided by the Trans Metro Bandung (TMB) Bus, Antar Kota Dalam Provinsi (AKDP – Inter City) Bus, Djawatan Angkoetan Motor Repoeblik Indonesia (DAMRI) Bus (a state-owned public transport service), and railways.Taxis and ride-hailing transport services such as Gojek and Grab are also widely available.

Figure 3.1 Bandung City Map

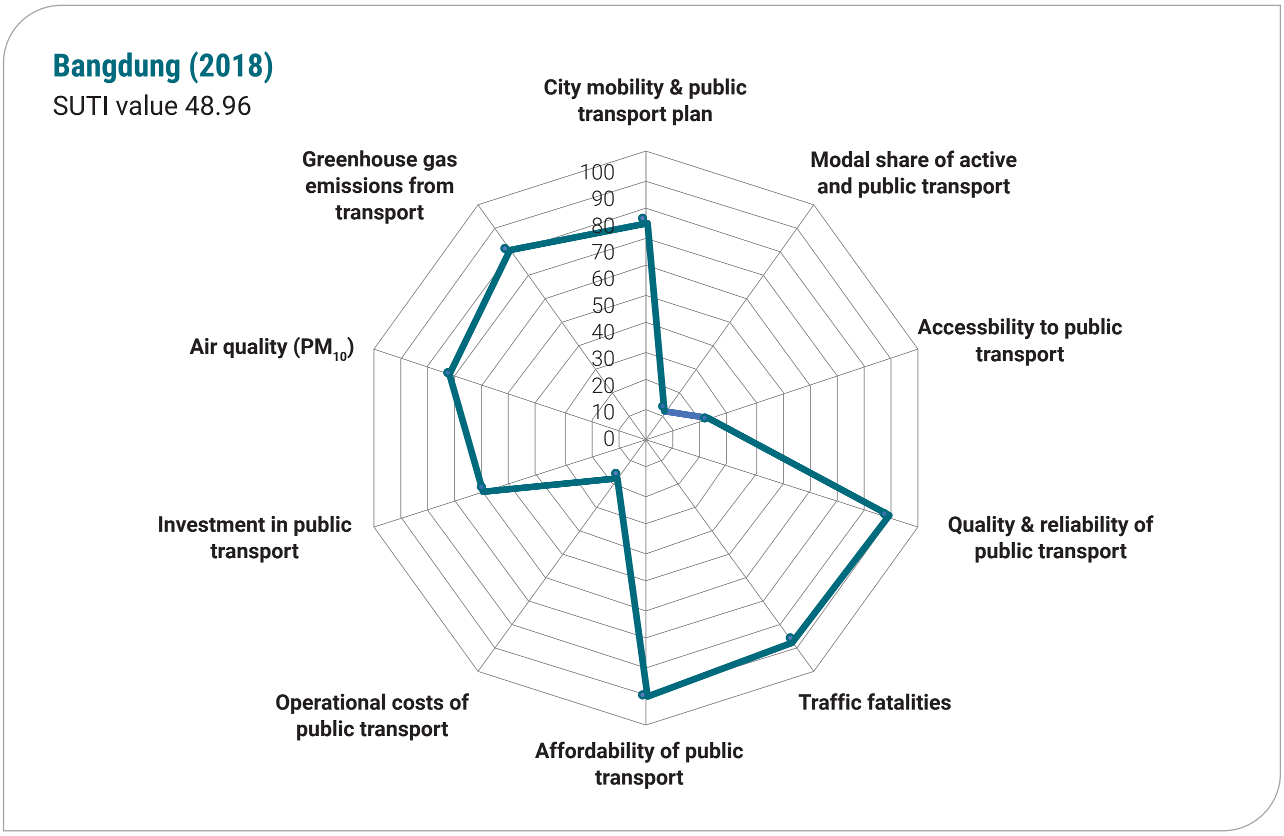
Figure 3.2 Scenes of congestion and Angkots in Bandung City

3.1.2 SUTI Results

The aggregate SUTI score for Bandung is 48.96.[27]

With 4.36 traffic fatalities per 100,000 inhabitants, the performance of Bandung with respect to Indicator 5 on road safety is relatively good. The low number of fatalities could be due to underreporting as the number of traffic incidents is high. Air quality is moderate. GHG emissions per capita is estimated to be low (0.53 tons per capita).

Figure 3.3 Bandung SUTI Spider Diagram



Public transport in Bandung is inadequate, and people are dependent mainly on the informal minibus system. The share of active transport is also low. The combined mode share of active and public transport accounts for only 19.34 per cent of total trips. People largely rely on two-wheelers to meet their mobility requirements. Private vehicle ownership rates are also high. Public transport access is poor, as the network coverage is limited and accessible by only 38 per cent of the population. However, the quality of public transport is rated high by the public. It should be noted that this rating covers only the BRT operated by the public sector. Fares are within the affordable range, with travel cost as a share of income of the lower 20 per cent population estimated to be 6.5 per cent. Lower fares also mean low-cost recovery (47.6 per cent) and a greater subsidy burden on the public sector. In the last five-year period, the investment in public transport is approximately 29.6 per cent of the total transport sector investment in the city.

3.1.3 Future perspectives

Bandung's commitment towards walking and bicycle networks as part of its future plans is very positive. The city also has plans to improve public transport. However, the SUTI assessment suggests that the city needs to focus on developing an integrated public transport system, improve transfer facilities among public transport modes, and expand the coverage of public transport systems. The city needs a reliable and high quality public transport that can attract customers who are current users of two-wheelers and Angkots. Reforms in the operation of the public transport system would help to improve the farebox ratio and reduce subsidies.

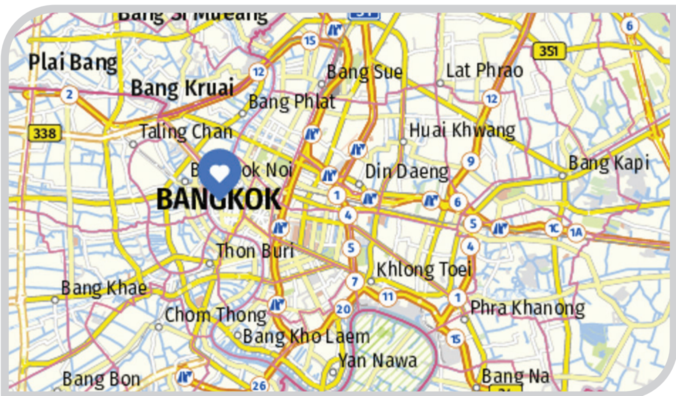
3.2 Bangkok (2020)

3.2.1 City Overview

Bangkok is home to almost six million people. It covers an area of 1,568.73 km^2 and has a population density of 3,690 persons per km^2. However, the city has sprawled into many surrounding provinces, which together form Greater Bangkok or the Bangkok Metropolitan Region. According to the National Statistic Office, this region has a population exceeding 15 million.

The city is naturally polycentric. The central business district is a combination of many sub-centres sprawling into one another. The roads are mainly arranged in a ring and radial system, with key roads running from the city centre outwards. These main roads are connected by a web of collector street networks, known as "sois". Business and commercial settlements and large condominiums are located on the main roads, while lower density residential areas are dispersed around these soi networks.

Figure 3.4 Bangkok Metropolitan Region



Bangkok Metropolitan Authority has developed the Bangkok Development Plan (2013-2032) to establish a framework for providing public services and to prioritize long-term project investment. The 20-year development plan is further divided into four phases of five years so that goals and measures can be reviewed and evaluated. Currently the second development plan (2018-2022) is in effect, with a vision of a "convenient metropolitan city".

The Bangkok mass transit network is comprised of two main modes: rail and bus. It is estimated that the rail network accommodates more than five million trips per day, while buses carry close to four million trips per day. Although water transport is widely used, the network is limited to the main river and two canals, and the ridership is lower than the other two dominant modes.

Since 1994, Bangkok's railway network has been developed through a series of rail transit master plans. The Mass Rapid Transit Master Plan in the Bangkok Metropolitan Region (M-Map) was proposed in 2008. M-Map was developed with the concept of trunk and feeders, in which the main line or trunk enabled mobility from key origins to destinations, and feeders facilitated accessibility to low density areas. The network was planned in a radial and circumference pattern. As of December 2020, the network consisted of six Lines: Light and Dark Green Lines, Blue Line, Purple Line, Airport Rail Link, and the newly opened LRT Gold Line. There are 123 Metro Stations across a total of 169 km.

The rail transport business in the city belongs to three main owners - Bangkok Metropolitan Administration (BMA), Mass Rapid Transit Authority of Thailand (MRTA) and State Railway of Thailand – who hire separate operators to run the services – Bangkok Transit System (BTS), Bangkok Metro Company Limited (BMCL, later merged with BECL to form Bangkok Expressway and Metro: BEM) and SETET (subsidiary company of State Railway of Thailand). Meanwhile, the Bangkok Mass Transit Authority (BMTA) operates part of the bus system itself and gives licenses to private companies. In 2019, it was reported that BMTA owns 3,005 buses, while private joint companies own 9,927 buses, bringing the total to 12,932 buses. A total of 456 bus routes are in operation in Bangkok and its vicinity. Most buses use natural gas as their fuel.

Figure 3.5 Complete M-Map Network

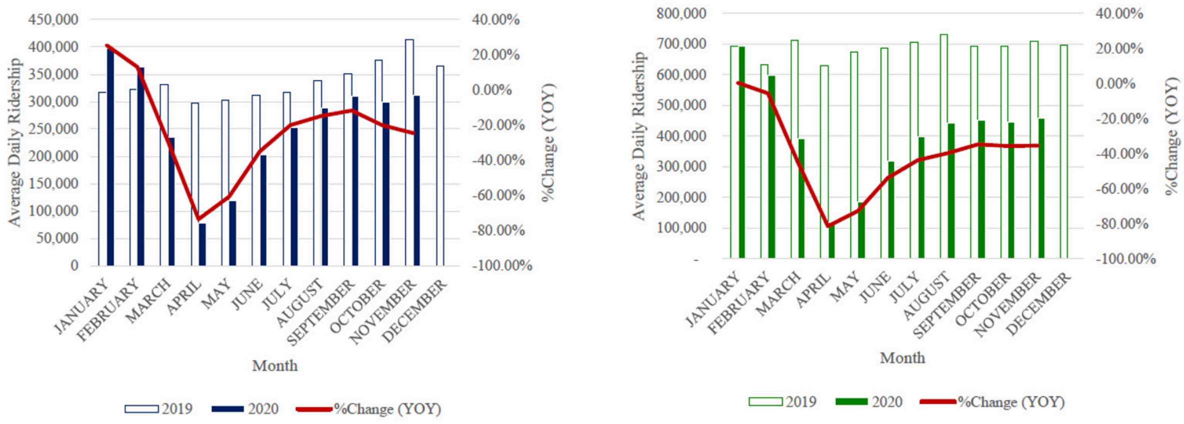
Hired transportation in Bangkok is dominated by taxis and motorcycle taxis, which play an important role in connecting people to transit stations and stops. Motorcycle taxis are stationed together in places known as "wyn". These stations are normally located at the intersection of collectors and arterials, mass transit stations, major bus stops, activity centres and communities where there is a lot of pedestrian and transit traffic. Ride-sourcing services have become a legitimate competitor to high-priced mass transit. Motorized three-wheelers or "tuk-tuks" also function as a connector mode between transit stations and final destinations. The fare rate is comparable to that of motorcycle taxis.

Figure 3.6 **Bangkok's Hired Transportation (left to right: Motorcycle taxi, tuk-tuk, taxi)**

3.2.2 COVID-19 situation

Travel demand started to fall in February 2020 and reached its lowest point in April 2020 due to the work-from-home policy. Traffic gradually picked up in the following months and maintained a stable trend, although it was considerably lower than the previous year's average.. Public transport systems took up various precautions and safety measures to control the pandemic. Passengers had their temperature checked at the gate of metro stations and had to wear masks at all times in transit. Social distancing was mandated through markings on the platforms and queuing areas, and hand sanitizers were provided. Bus passengers also had to wear masks at all times during the journey. The social distancing measures reduced public transport capacity by 30-40 per cent for all trips. Public transport lost more patronage than the expressway. Along with loss of revenue due to low ridership, the business performance was affected by the additional costs of measures adopted against COVID-19. Other modes of transport such as taxis, vans, and motorcycle taxis have also been affected. For hired transport services, revenue fell by 40-45 per cent, while revenue for rail modes went down by 30 to 35 per cent.

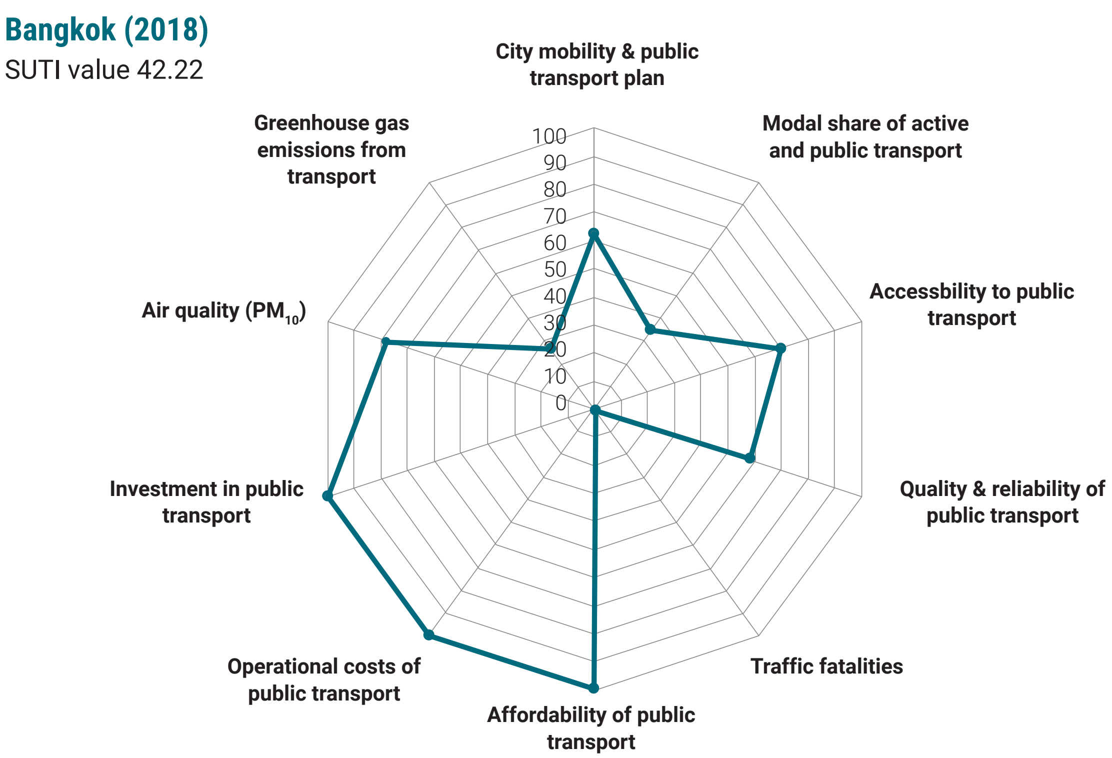
Figure 3.7 COVID-19 Impact on Bangkok Blue Line (left image) and Green Line (right image) ridership



3.2.3 SUTI Results

The aggregate SUTI score for Bangkok[28] is 42.22.

Figure 3.7 Bangkok SUTI Spider Diagram



Thailand has one of the worst traffic safety records in the world. The national road accident fatality rate in 2019 was 38.1, while the Bangkok rate was 10.3. Air quality has also been of great concern over a long period. PM_{10} was selected over $PM_{2.5}$ as an indicator for the SUTI Indicator 9 calculation, as its values are more in the maximum-minimum range (i. e. 10-150 units) of the SUTI scoring system. PM_{10} values range from 17 to 94 units, with an average of 40.89 and a median of 38, while $PM_{2.5}$ values range from 34 to 177 units, with an average of 83.40 and a median of 77.

Private cars and motorcycles contribute to 30 per cent and 20 per cent of work and education trips respectively, while transit trips account for 37 per cent of mode share. The average expense on transport systems comes to 3.52 per cent of the average monthly income. The affordability numbers may be distorted as commuters often have to pay the fare every time a transfer occurs on multimodal trips.

The Bangkok Development Plan (2013-2032) does not incorporate any strategy specifically dedicated to pedestrian mobility. Although the Plan does not specifically include intermodal facility development plans, the Office of Traffic and Transport Policy and Planning and Department of Rail have commissioned intermodal facility development studies. The overall public transport network needs new planning. The Bangkok Development Plan includes a specific strategy to develop Bangkok as a green and convenient city. The total investment for the transportation sector in 2019 was 396,831 million baht and the investment for urban rail sector (i.e., M-Map network) was 160,448 million baht. The rest of the budget is assigned to intercity motorway, railway, aviation, and freight.

3.2.4 Future perspectives

The strengths of the city's urban transport, as suggested by the SUTI score, include the public transport plan (Indicator 1) and convenient access to public transport (Indicator 3).

SUTI provided new insights into some areas which need further improvement, such as: immediate evaluation and improvement of public transport routes; fare and service integration of various public transport modes by implementing a common ticket program; prioritizing infrastructure for non-motorized transport; adopting pricing strategies for mass transit to compete with private modes; measures to increase the share of public transport modes; and effective enforcement of traffic laws and other policy measures to reduce the number of road accidents and fatalities. To further enhance environmental sustainability, Bangkok is considering a transition to electric mobility. The private sector is already operating some electric buses and boats in Bangkok.

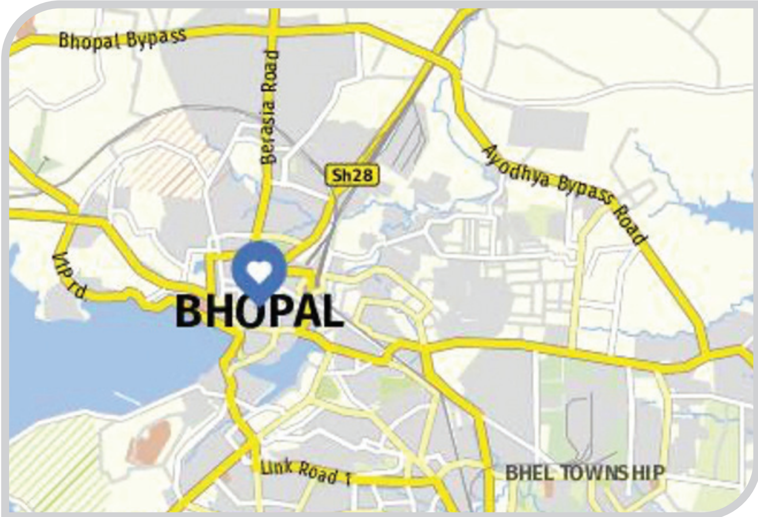
3.3 Bhopal (2019)

3.3.1 City Overview

Bhopal, the capital of the Madhya Pradesh state in India, is also known as the "City of Lakes". The Bhopal Planning Area spans over 813 km^2 and houses a population of 2.018 million people. The study area included the planning area of 505 km^2, a municipal area of 258 km^2 and the surrounding villages across 50 km^2. The Bhopal Municipal Corporation area is further divided into 70 administrative wards, with ward boundaries further aggregated into 14 planning zones.

The city has a hierarchical road network system. The total length of road network within the Bhopal Planning Area is 3,859 km. The road density is highest in Old Bhopal (3.24 km per km^2), followed by South and South-West Bhopal (1.70 km per km^2). Areas outside the Municipal Corporation have the lowest road density of 0.31 km per km^2.

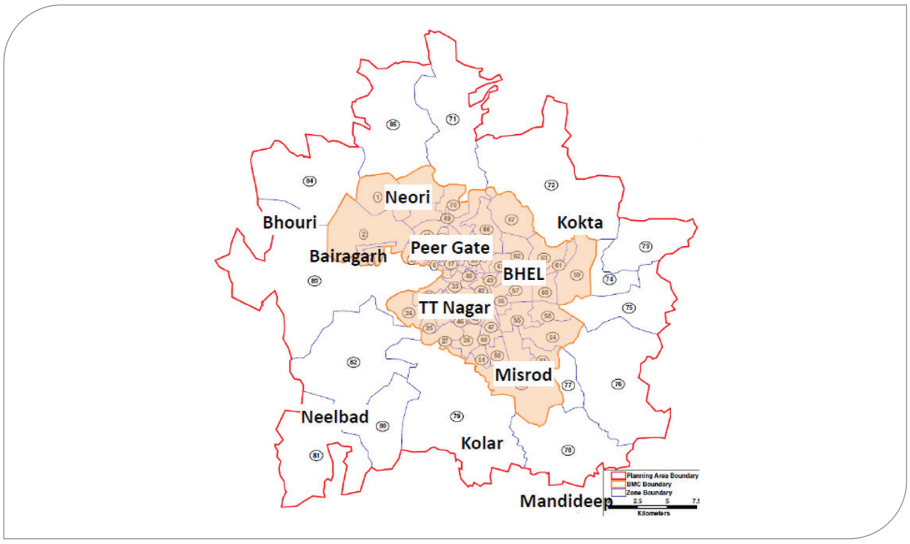
Figure 3.8 Bhopal City Map



The average rate of vehicular growth since 2002 has been about 10 per cent per annum. The per capita trip rate (PCTR) for the study area is observed to be 0.96, excluding intra-zonal trips. The total vehicular population registered in 2011 was about 790,000, of which 80 per cent were two-wheelers. Two-wheelers account for 25 per cent of all trips, while the share of public transport is 25 per cent. The share of walking and cycling trips is 43 per cent, which is relatively high. This may be due to the compact and mixed land use development in the city.

In Bhopal, the public transport system consists of the city bus service and Bus Rapid Transit System (BRTS), which are operated on a Net Cost Contract model by the transit authority. There are presently 287 buses operating on 15 routes (with a route length of 401 km). The BRTS operates on a corridor length of 24 km. The bus system carries about 900 trips per day, amounting to 46,937 vehicle km daily. The average daily ridership of the bus system in Bhopal is 165,000, with the highest ridership of 210,000 recorded in 2019.

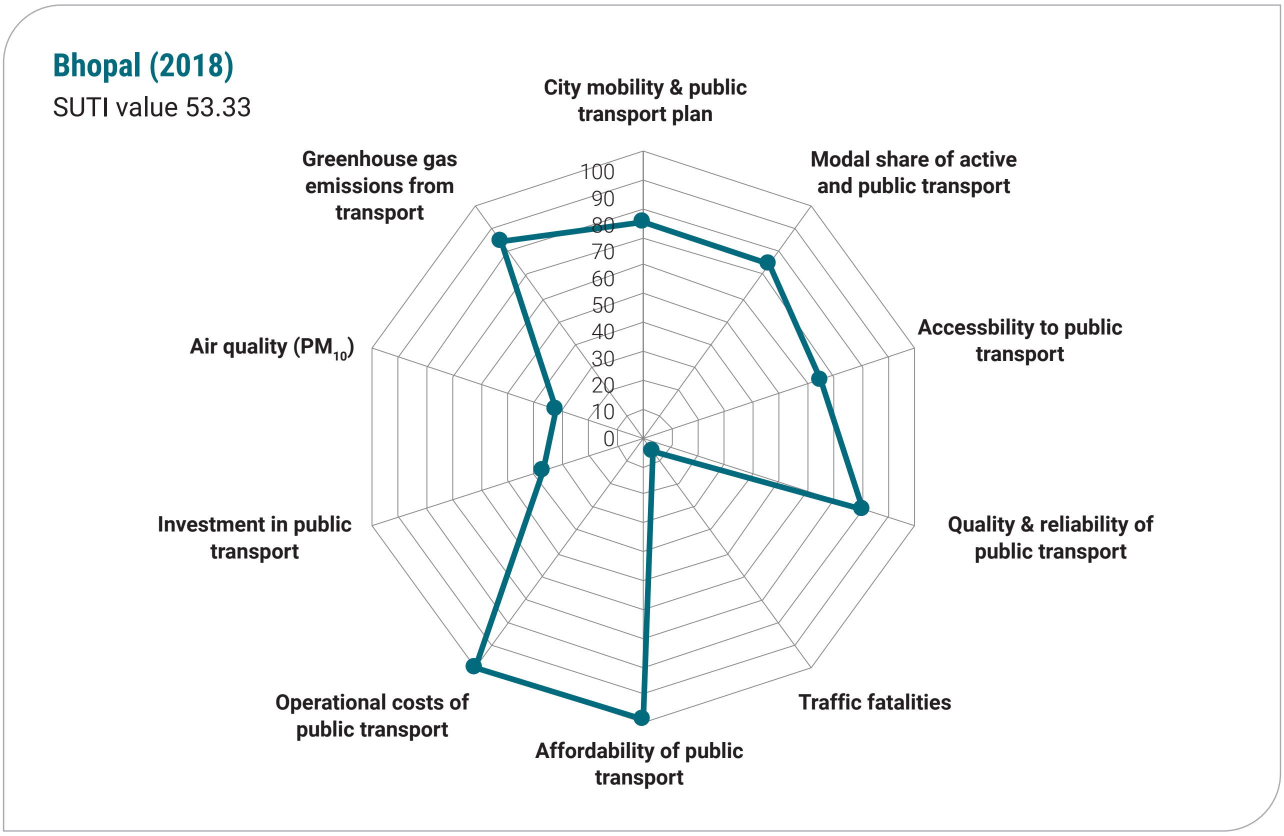
Figure 3.9 Bhopal Planning Area



3.3.2 SUTI Results

The aggregate SUTI score for Bhopal is 53.33

Figure 3.10 Bhopal SUTI Spider Diagram



The city's vision of sustainable mobility is articulated in its Comprehensive Mobility Plan 2031. During the last five years, the city has been investing moderately in the development of its public transport system (18.7 per cent of total transport investment). In Bhopal, the modal share of public and active transport is relatively high (70 per cent), with 72 per cent of the population having convenient access to public transport. The quality and reliability of public transport is also moderate, with 82.4 per cent of the users satisfied with the service. Fares are affordable, with low-income groups spending an average of 4 per cent of their income on transport. Since the public transport operator runs on the Net Cost Contract Model, the government recovers 100 per cent of the cost of operations.

However, the city's traffic safety performance was 9 fatalities per 100,000 inhabitants. Though the per capita GHG emissions are low (0.44 tons/annum), the inhabitants of the city suffer from poor air quality (PM_{10} – 105 µg/m^3).

Figure 3.11 BRTS Corridor in Bhopal

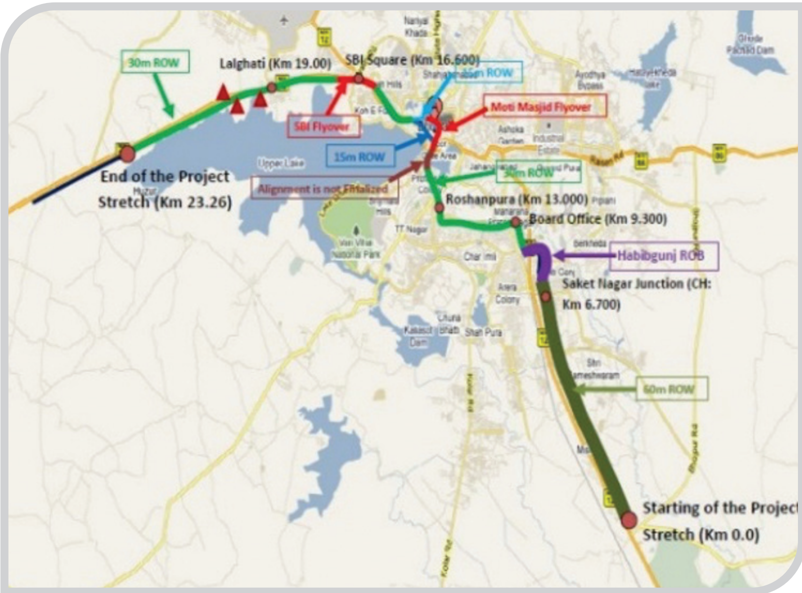


Figure 3.12 Public transport and cycle track in Bhopal

3.3.3 Future perspectives

SUTI provided new insights into the areas of focus to improve public transport planning in Bhopal. These include taking urgent measures to reduce the fatality rate and improve road safety, increasing investment on public transport, working with the state government to monitor PM_{10}/ $PM_{2.5}$ over a wider geographical region, in addition to taking up actions for better air quality management and introducing cleaner vehicles, both for public transport and intermediate public transport/paratransit, in line with the central government's vision towards electric mobility.

3.4 Colombo (2017)

3.4.1 City overview

The Western Region of Sri Lanka is comprised of three administrative districts, Colombo, Gampaha and Kalutara. Within this area, the SUTI assessment was conducted in 33 divisional secretariat divisions. Western Region has a geographical spread of 3,684 km^2, with an estimated population of 6.2 million in 2021. This region is the main economic hub of the country, contributing to nearly 42 per cent of the country's GDP (3,643.2 billion rupees out of 8,674.2 billion rupees in 2013). The area also recorded the highest per capita income in 2012 compared with the rest of the country.

The latest Transport Master Plan is the Western Region Megapolis Plan, developed in 2016. It provides a framework for urban transport development in the area up to 2035. The Urban Transport System Development Project for Colombo Metropolitan Region and Suburbs (CoMTrans) developed a master plan proposing future public transport and active mobility strategies, including better walking and cycling infrastructure facilities for the Western Region. The study also suggests developing six major and five minor multimodal transport centres within the study area.

Public transport in the Western Region is comprised of buses and trains. Of the total 10 million trips made per day, 40.4 per cent are by public transport, while another 22 per cent are on non-motorized transport. Rail services are provided by Sri Lanka Railways, a public sector entity. A total of 531 km of the rail network covers the Western Region, with 61 train stations. The passenger bus services are provided by the Sri Lanka Transport Board and private bus owners. In the study area, the bus system is comprised of 6,448 buses running on 433 bus routes, with approximately 48,000 trips per day and a daily ridership of 3.8 million in 2017.

Figure 3.13 Colombo City Map

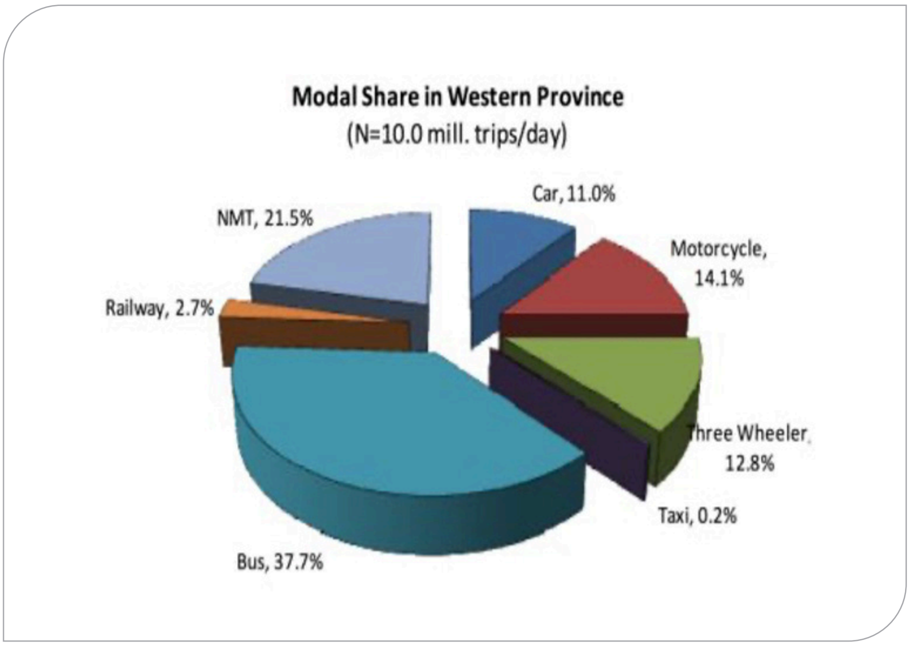
3.4.2 SUTI Results

The aggregate SUTI score for Colombo[30] is 32.7.

In Colombo, only 7 per cent of passengers are satisfied, suggesting that the quality and reliability of public transport is a concern. The accessibility to public transport service is low (only 44 per cent of population have easy access). Traffic safety performance is also another area of concern at 15 fatalities per 100,000 inhabitants.

The modal share of public and active transport is moderate (75 per cent). Fares are within the reach of affordability, with low-income groups spending an average of 12.8 per cent of their income on transport. The public transport operator recovers 94 per cent of cost in its operations. During the last five years, the city has been investing moderately in the development of the public transport system (24.8 per cent of total transport investment). The per capita GHG emissions in the city are low (0.63 tons/annum) and the inhabitants of the city experience moderate air quality (PM_{10} – 46 μg/m^3).

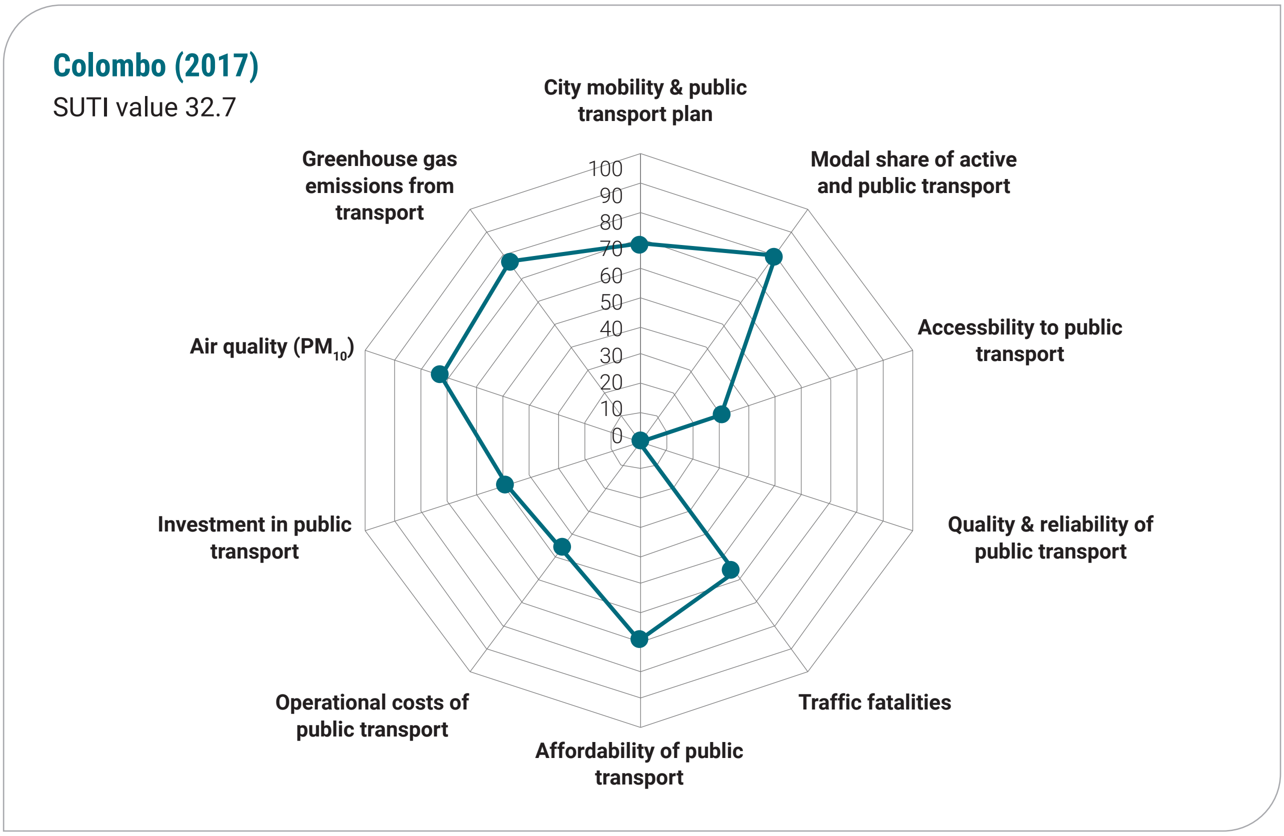
Figure 3.14 Modal mix in Western Region



3.4.3 Future perspectives

SUTI provided new insights into the areas of focus for the Western Region, Sri Lanka. These include ensuring a better quality and reliable public transport system for the passengers, increasing network coverage by planned development of public transport network, and designing measures to reduce the fatality rate caused by traffic accidents. Frequent changes in the administration have led to revisions of public transport plans and have also delayed their implementation.

Figure 3.15 Colombo SUTI Spider Diagram



3.5 Dhaka (2018)

3.5.1 City Overview

Dhaka is one of the most densely populated cities in the world, accommodating an estimated 18 million people in an area of 302 km^2. The population of the city is expected to rise to 35 million by 2035.

Dhaka is a centre for production of woven garments, leather, information technology and telecommunications. Woven garments contribute to 49 per cent of formal jobs. However, it has recently been observed that the concentration of these industries is shifting towards peri-urban areas.

Dhaka is a polycentric city. The spatial extent of Dhaka is an outcome of its topography, socioeconomic characteristics and transport system. Dhaka's road network is comprised of approximately 3,000 km of roads (200 km primary roads, 110 km secondary roads, 50 km feeder roads, and 2,640 km narrow local roads), which account for 7 per cent of the total built-up area in the city. However, there are only 400 km of footpaths, of which nearly 40 per cent are illegally occupied or not suitable for use.

There are 3.4 million registered vehicles in Dhaka city. Among these, the number of registered buses and minibuses are 9,311 and 8,459, respectively . On an average working day, about 21 million trips are made in the Dhaka Municipal Authority (DMA) area. Out of all trips taken each day, trips to school constitute 17.7 per cent, trips to home 12.6 per cent, and trips to work approximately 44.7 per cent. There are 152 bus routes in the DMA, among which only five bus routes are in the East–West direction. The public transport modes account for more than 80 per cent of the mode share. The average length of a bus trip is 9.7 km and a rickshaw trip is 3.6 km.

Figure 3.16 Dhaka City Map

Figure 3.17 Dhaka - Traffic and City Transport Services

Redeveloped Footpath in Gulshan Area

Water Taxi in Hatirjheel

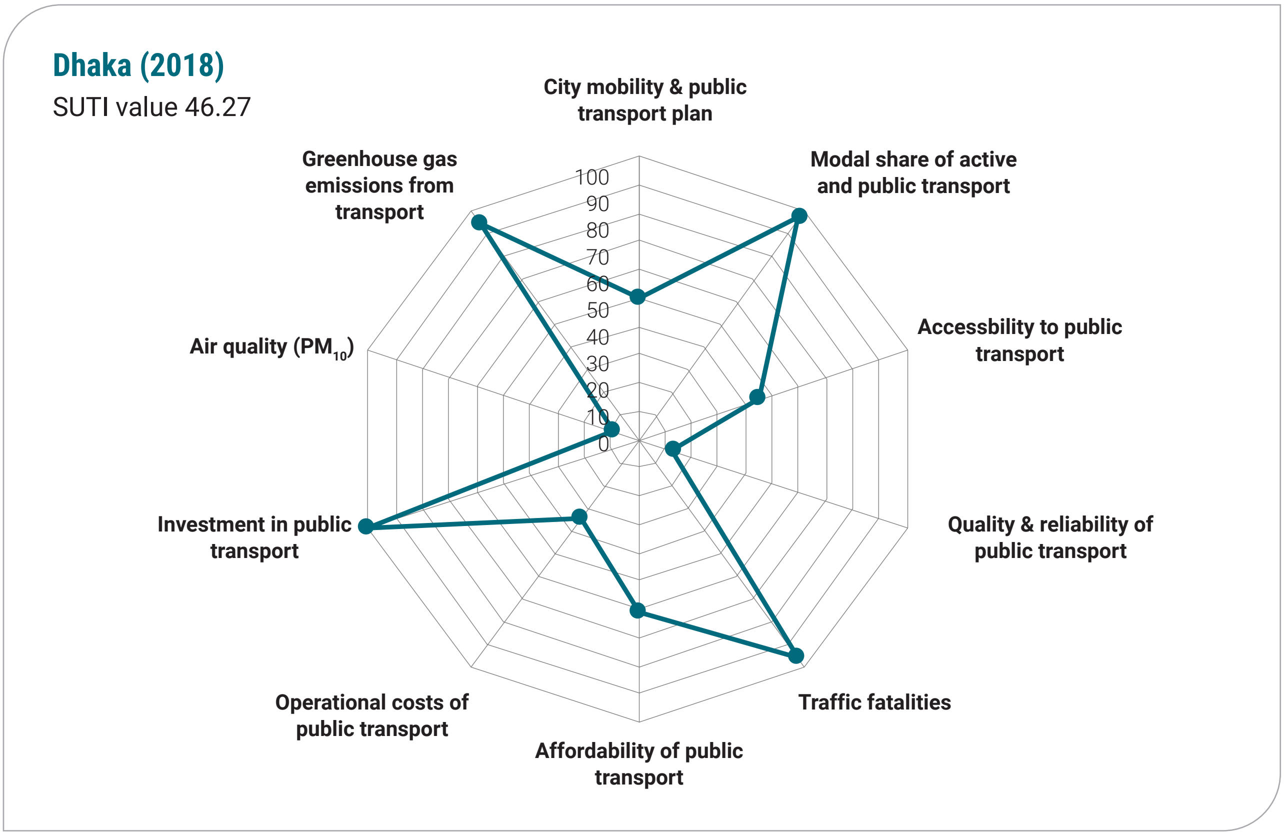
3.5.2 SUTI Results

The aggregate SUTI score for Dhaka is 46.27.

The air quality in the city is very poor (PM_{10} – 137 μg/m^3), and the quality and reliability of public transport is 'poor' (37.9 per cent satisfied passengers).

The people of Dhaka are predominantly dependent on the privately-operated bus transport system, cycle rickshaws and walking to meet their mobility needs, and these modes account for a mode share of 87.1 per cent. Despite this high share of public transport ridership, extreme congestion occurs due to limitations in the road network and increasing rates of private vehicle ownership. Public transport access is limited to only 56.5 per cent of the population. However, traffic fatalities are relatively low at 2 fatalities per 100,000 inhabitants. Public transport fares are moderate, with 20 per cent of the low-income population spending an average of 15.8 per cent of their monthly income on transport. Public transport services are operated by private operators and are able to recover 74.23 per cent of the operations costs. However, there is speculation that the operators are understating their revenues. The per capita GHG emissions in the city are also low (0.16 tons/annum).

Figure 3.18 Dhaka SUTI Spider Diagram



3.5.3 Future perspectives

The city has developed an ambitious public transport plan. It has started bridging the gaps in public transport through investments, and in the past five years, the entire expenditure on transport in the city has been dedicated to improving the public transport system. Construction on BRT and MRT is progressing. However, without city-wide development of public transport including investments in walkability and bicycle infrastructure, access to public transport and traffic congestion will continue to be an issue.

3.6 Hanoi (2017)

3.6.1 City Overview

Hanoi is the capital city of Viet Nam, and the cultural and political center of the country. It is comprised of 30 urban/suburban districts, with 584 precincts and towns. Hanoi, with an area of 3,348 km^2 and 69.7 per cent urbanization, houses a population of 8.05 million persons (average population density of 2,406 persons per km^2). The density is unevenly distributed; the densest inner-city area houses 41,602 persons per km^2. Hanoi's economy ranks second in Vietnam after Ho Chi Minh City. With its development of industries, finance, commerce and services, the city is the centre of the Red River Delta economy.

Figure 3.19 **Hanoi City Map**

There are 23,272 km of road in the study area, of which the Department of Transport manages 1,989 km; the People's Committee of District manages 1,975 km; and the People's Committee of Commune, Son Tay Ward manages 19,282 km. The urban transport network is comprised of 1,206 roads with a total length of 2,193 km. According to the Viet Nam Registry Department and Hanoi City Police, there were 6.09 million motorbikes and 460,000 passenger cars in 2019 within the city. The growth rate of cars and motorcycles are estimated to be 16.77 per cent/year and 5.5 per cent/year, respectively. Of the total number of vehicles, motorcycles account for 90 per cent, cars account for 7 per cent, and buses only account for 0.43 per cent.

The public transport system in Hanoi City is mainly represented by the bus, including BRT. The bus network includes 127 routes with an operating length of 4,156 kilometers, and a transport volume of 484.5 million passengers per year. There are a total of 1,952 buses in Hanoi. The BRT system started in 2016 with a length of 14.74 km and caters to an average of 460,000 passengers per month. There is also an urban railway network consisting of nine lines with a total length of 417.8 km; five routes are in the central area and four routes connect to satellite towns and suburbs. There are also three monorail tram lines.

Figure 3.20 Public transport in Hanoi

3.6.2 SUTI Results

The aggregate SUTI score for Hanoi is 32.40.

In Hanoi, the modal share of public and active transport is low (14.27 per cent). During the last five years, the city has been investing very little in the development of the public transport system (only 2.3 per cent of total transport investment). In addition, the public transport operator recovers only an estimated 39 per cent of the cost of operations. The inhabitants of the city suffer from poor air quality (PM_{10} – 78.97 µg/m^3).

The public transport quality and reliability performance is moderate (52 per cent satisfied passengers). The access to public transport service is convenient and good (81 per cent of population). Traffic safety performance is moderate (6 fatalities per 100,000 inhabitants). Fares are affordable, with low-income groups needing to spend an average of 4.7 per cent of their income on transport. The per capita GHG emissions in the city are low (0.62 tons/annum).

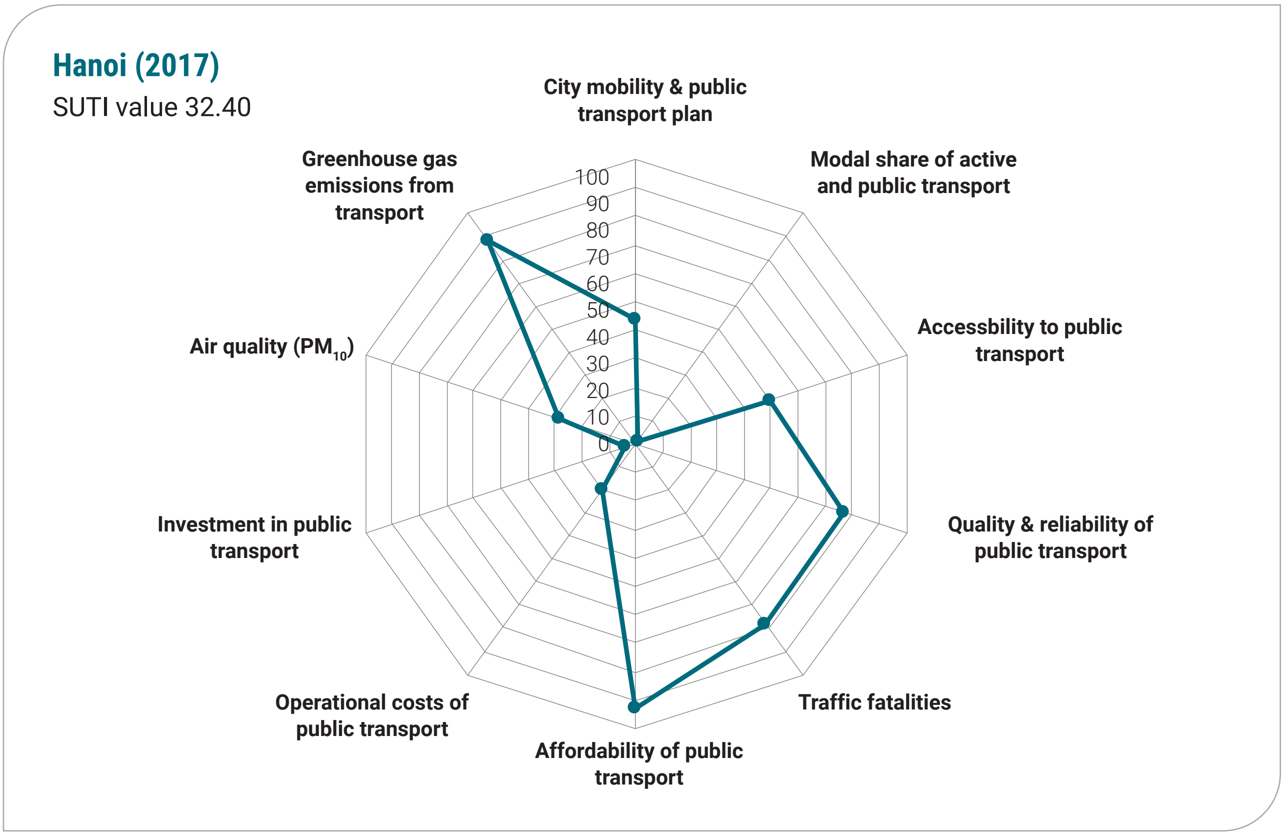
3.6.3 Future perspectives

SUTI provided new insights into the areas of focus for Hanoi, Vietnam.

The Vision 2050 plan for the city is focused on public transport networks and support modes (walking, cycling), as well as on connecting transportation of different types, and is expected to bring positive changes to the city's transportation system.

Currently two mass transit systems are under development. Their completion and operation would help to improve mode share and accessibility. Given the low share of investment in public transport by the government and Hanoi city, investments in public transport services need to be increased.

Figure 3.21 Hanoi SUTI Spider Diagram



The mode share of public transport is very low despite the various forms of public transport. Policy measures are required to increase modal share of public transport and active mobility through defined strategies and dedicated allocation of funds.

The city needs to improve air quality by promoting mode shif to public transport modes, the use of renewable energy in public transport and accelerating transition to electric mobility.

The high share of motorcycles in the vehicle fleet poses a serious safety issue, and there is an urgent need to implement road safety action plans to reduce traffic fatalities in Hanoi as well as in Viet Nam in general.

3.7 Ho Chi Minh City (2018)

3.7.1 City Overview

Ho Chi Minh City (HCMC) is the economic and financial centre of Vietnam. According to the Statistical Yearbook 2017, the population of Ho Chi Minh City is 8.61 million. The population growth rate recorded between the period 2005–2017 was 3.16 per cent per year.

HCMC is located in the south-eastern region of Vietnam, about 1,730 km away from Hanoi by road. The city centre is located 50 km away from the coastline of the South China Sea. HCMC plays an important role as the transport hub for all modes —roads, waterways and airways —linking various provinces in the region and also being an international gateway for South East Asia. HCMC is a major manufacturing centre and contributes 25 per cent of Viet Nam's production. Many multi-national corporations are in the process of locating to or expanding their manufacturing plants in Viet Nam.

The city's average population density is 4,029 persons per km^2,with a higher concentration in the central area. The total road length is 4,202 km, of which the majority of roads are narrow (only 1,827 km of road network are over 7m wide). The percentage of land use categorized as transport/road is still low, ranging from 5.2 per cent to 21.4 per cent.

In 2017, the vehicle population consisted of 285,612 cars, 32,242 buses, 7.4 million two-wheelers and 199,102 other vehicles such as trucks and specialised vehicles. A total of 2,359 buses are operating within the city, and another 244 buses operate on inter-provincial routes. The operation of urban buses is subsidised.

Figure 3.22 Ho Chi Minh City Map

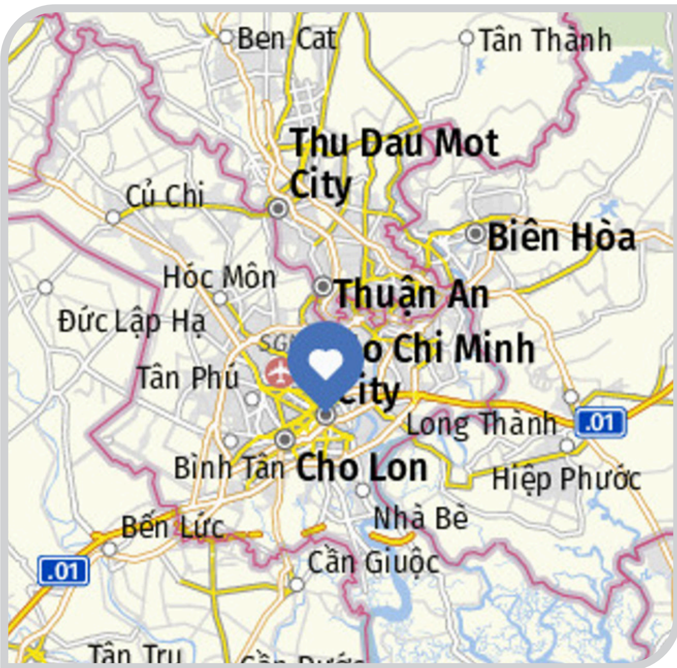


Figure 3.23 Ho Chi Minh – traffic and city transport services

Ho Chi Minh City Roads

CNG Buses in Ho Chi Minh City

3.7.2 SUTI Results

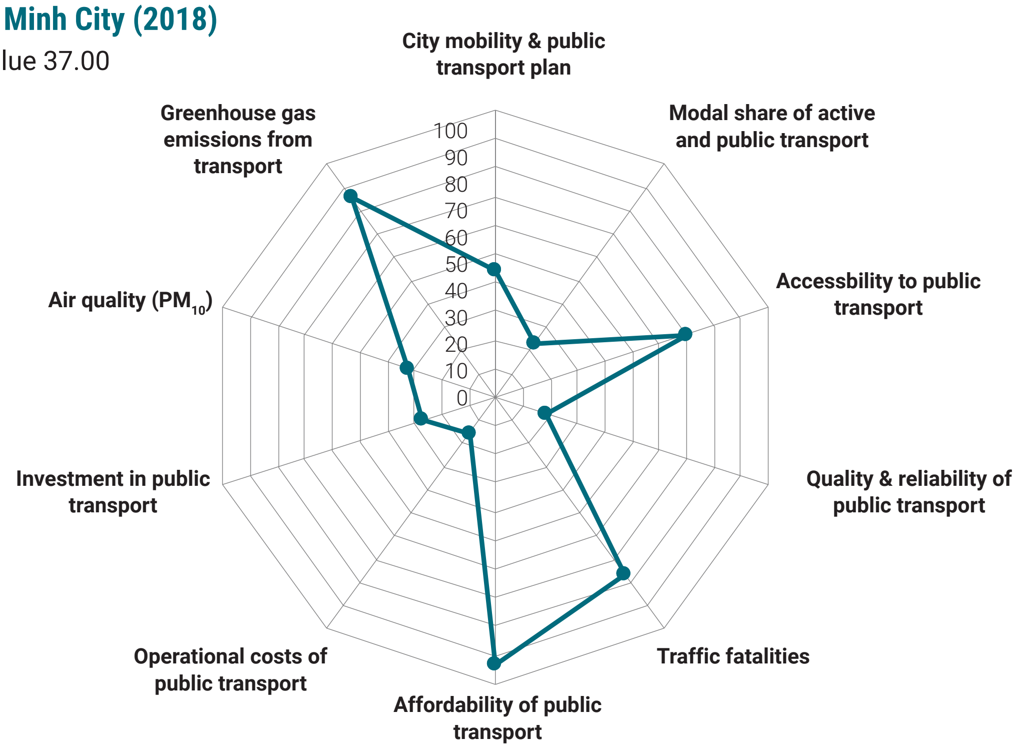
The aggregate SUTI score for Ho Chi Minh City is 37.00.

In HCMC, traffic safety is a major concern with 8 fatalities per 100,000 inhabitants. The per capita GHG emissions in the city are low (0.38 tons/annum), but the inhabitants of the city suffer poor air quality (PM_{10} – 105 µg/m^3)

Figure 3.24 Ho Chi Minh City SUTI Spider Diagram

Ho Chi Minh City (2018)

SUTI value 37.00



Mobility in HCMC is largely by personalized vehicles, mainly two-wheelers. In terms of mode share, two-wheelers predominate, accounting for over 70 per cent of total trips. Public transport, walking and cycling together account for only 28.5 per cent of trips. The share of public transport is low at 5 per cent. The coverage of public transport network is moderate, with 76 per cent of the population residing within a 500 meter range of public transport stops. People rate the quality and reliability of public transport as 'poor' (41.7 per cent satisfaction rate). The fares on the public transport are generally within affordable limits (average monthly public transport expenditure is 4.4 per cent of income). The cost recovery of public transport is very low (46 per cent). During the past five years, HCMC has made limited investments in public transport, allocating only 13 per cent out of total transport investments. However, the construction of the metro is progressing in HCMC.

A strategic plan for transportation development in HCMC has been prepared and approved by the Prime Minister. The plan mainly focuses on public transport, with nominal focus on walking, non-motorized transport, and multi-modal integration. The assessment team of SUTI assigned it a score of 7 out of 16.

3.7.3 Future perspectives

The city needs to focus on achieving the targets set as part of the strategic plan through investment in public transport. Infrastructure for walking, bicycling and multi-modal integration should also be prioritized. There is a need to enhance quality and reliability of public transport and recover operation cost.

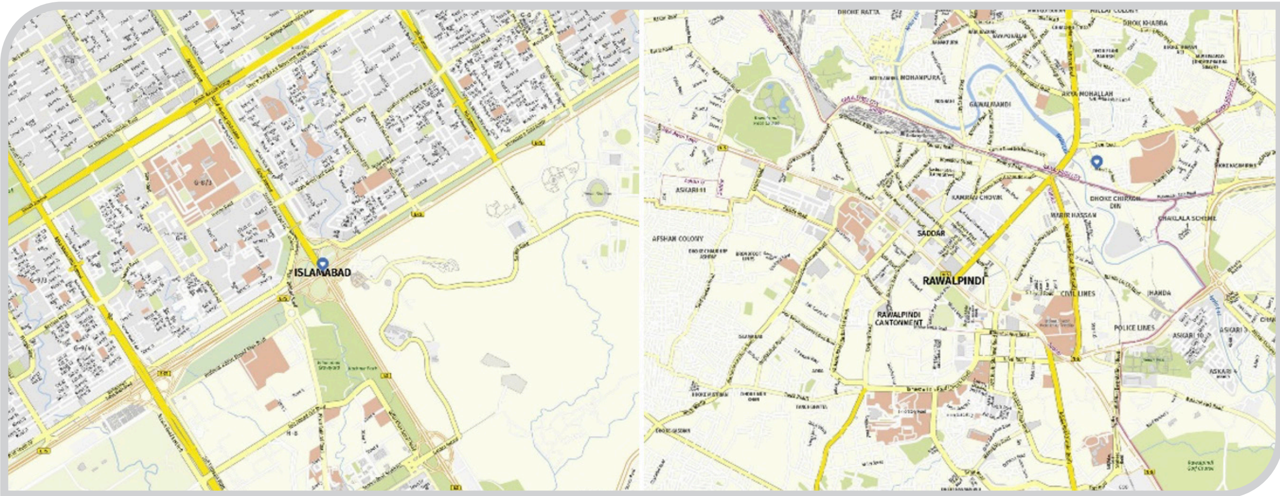
3.8 Islamabad and Rawalpindi (2021)

3.8.1 City Overview

Islamabad is the capital of the Islamic Republic of Pakistan. The city has a geographical area of 906.5 km^2, out of which 25 per cent is urban. The population in 2017 was 2 million, with a density of 2,211 people per km^2. Its neighboring city Rawalpindi shares a strong social and economic linkage; the two are known as Twin Cities. Rawalpindi is geographically contiguous and therefore its transport system should be considered together with the transport system of Islamabad. In total, the two cities have more than 4 million people, with many people commuting between the two cities daily. The city has been divided into 84 sectors; each sector is further divided into five sub-sectors, four residential and one commercial (the 'Markaz' subsector). The main commercial area known as the Blue Area is considered to be the Central Business District of Islamabad. Compared to Islamabad, Rawalpindi is not well planned and has a high density of population.

Islamabad has seen a rapid increase in traffic over the past few years due to increases in population, car ownership (made more affordable with leasing schemes), as well as in response to the lack of public transport systems. However, an estimated 42 per cent of trips are made by public transport. Rickshaws and Qingqis operate exclusively in Rawalpindi and are used as a point-to-point taxi. Fares depend on the time of day, demand, and distance. These two types of motorcycle rickshaws are prohibited in Islamabad. Taxis are a common mode of transport for middle-income families without cars in both cities. Since the Yellow Cab Scheme was introduced in 1992, in which 15,000 cabs were distributed among unemployed individuals, there have been a large number of taxis on the roads.

Figure 3.25 Islamabad and Rawalpindi City Map



Islamabad Rawalpindi

Meanwhile, the Regional Transport Authority (RTA) and Islamabad Transport Authority (ITA) regulate and give route permits to the Hiace/Wagons, Suzukis, and Minibuses. These vehicles operate on 41 designated routes and make up 4,272 vehicles. Ride-hailing companies (including Uber, inDriver, Careem) have also recently expanded in both cities, meeting the needs of low-income groups with motorcycles and private cars, and significantly reducing the ridership of Hiaces and Suzuki mini-vans.

The BRT connects Islamabad with Rawalpindi, passing through major commercial and residential areas of both cities. Having been introduced in 2015, it is still a relatively new mode of transport. The BRT operates at a flat fare, and the current box recovery ratio is only 0.23, meaning that 77% of the BRT system is subsidized.

As part of this SUTI report, 210 people in Islamabad and Rawalpindi were interviewed in March 2021 about their daily trips before and after the COVID-19 pandemic. It was found that school and recreational trips were reduced by 70% and 60%, respectively, during the pandemic period (taken here as between March 2020 to March 2021, although two further waves took place in March/April 2021 and July/August 2021). A separate study on traffic demand on the Islamabad Expressway found that traffic demand on the expressway fell dramatically during the COVID-19 pandemic period. While the number of motorcycles and cars surpassed the number of the pre-COVID period, the number of public transport vehicles remained slightly below the pre-COVID period, suggesting that public transport took longer to recover from the pandemic. The number of BRT riders also fell dramatically from roughly 3.5 million per month to 2 million per month during and after COVID-19, due to the Government's quota of 50% occupancy during the pandemic and the public's fear of catching the virus.

3.8.2 SUTI Results

The overall SUTI Value for the Twin Cities is 30.36.

Despite the fact that neither Islamabad nor Rawalpindi have comprehensive master plans for public transport, the transport authorities are promoting various projects to support a more sustainable transport system in both cities. For example, to promote a cycling culture in the twin cities, concerned authorities organize cycle races in Islamabad and Rawalpindi, while the Capital Development Authority (CDA) has introduced cycling tracks on the major roads of Islamabad. Meanwhile, both the CDA and the Rawalpindi Development Authority are introducing electric buses along their bus routes, which is in line with the Government's Electric Vehicle Policy 2020 – 2025.

Regarding the modal share of public transport, it is estimated that about half of trips are done using the many different types of public transport modes. As both cities are relatively densely populated, the access to public transport is also quite high, with about 53% of the population living within a radius of 500m from a public transport stop. Based on economic survey reports by the Government of Pakistan for the year 2019, it was estimated that daily commuters spend 10.6 per cent of their monthly income on public transport use in twin cities.

On other indicators, the Twin Cities face some major challenges. The quality of the BRT received a high rating in terms of general indicators for passenger satisfaction, but passengers were less satisfied with other types of privately provided transport, such as minibuses, Hiaces and Suzuki vans. On the other hand, the cost recovery ratio for the BRT is about 23 per cent, meaning that the system depends on government subsidies to operate. Traffic safety also fared poorly, with 5.9 fatalities per 100,000 people. The PM_{10} Population weighted concentration was 126.53 for the twin cities. Greenhouse gas emission data for the cities was not available, but a recent World Bank study estimated it to be 0.98 metric tons per capita per year for the country.

Figure 3.26 SUTI Spider Diagram Islamabad and Rawalpindi

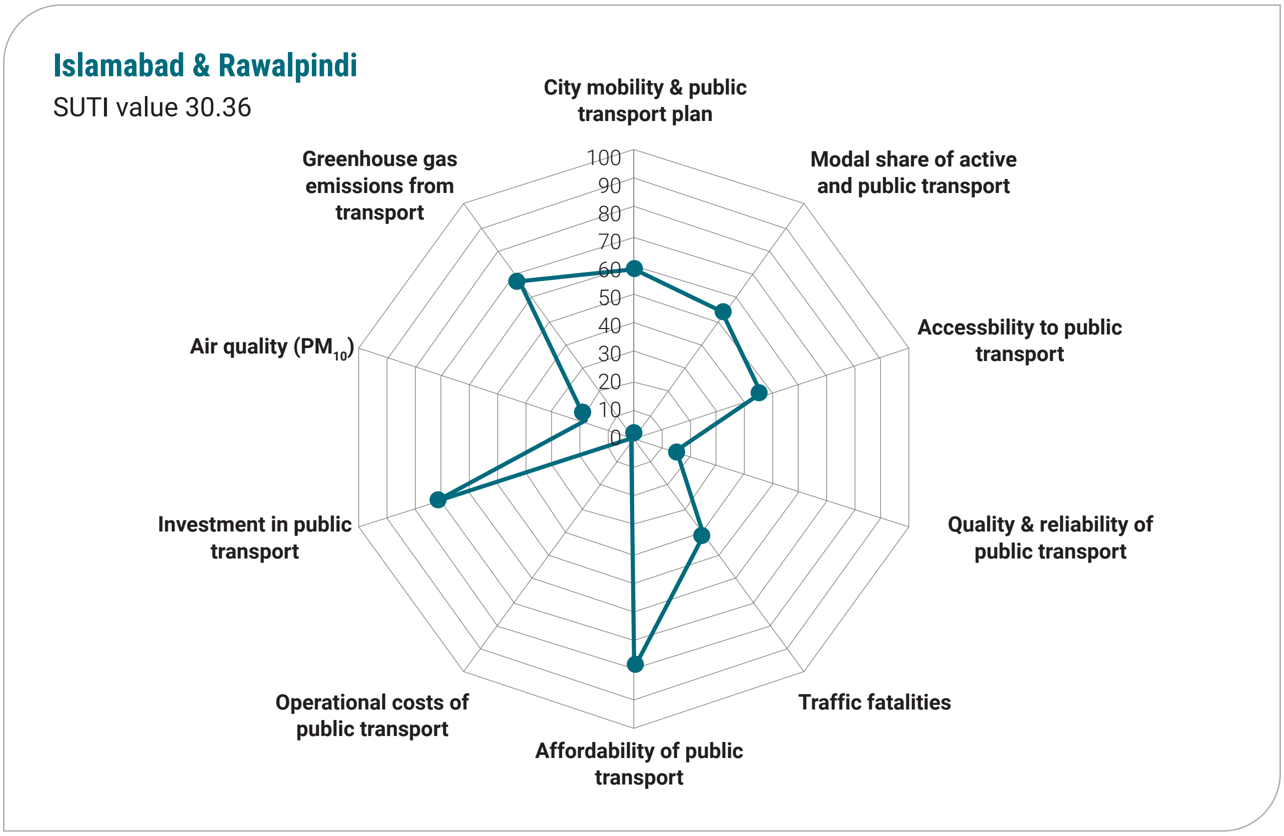


Figure 3.27 Public transport in Islamabad

3.8.3 Future perspectives

Public transport is generally moving towards better quality and more sustainable modes. Commuters considered the Islamabad Rawalpindi BRT to be a reliable, safe, and efficient mode of transportation, but showed dissatisfaction about privately owned public transport modes, i. e. Hiaces, vans, Sukuzis, and minibuses. To address these shortcomings, the authorities should formalize these modes and strengthen the enforcement of vehicle inspection and safety standards, using their authority to issue route permits as an incentive.

While it is normal for public transport to receive some financial support from the government, the current farebox ratio for the BRT is unsustainable. Further efforts should be made to support the Punjab Metrobus Authority to develop a better cost-recovery business plan for BRT, for example by selling advertisement space in bus stations, corridors, and buses.

The air quality index (PM_{10}) remains high for the twin cities, in large part due to the transport sector. Policies to introduce electric buses should be continued.

The number of fatalities per 100,00 inhabitants is also unacceptably high. The transport authorities should introduce a “Safe System” in the twin cities to reduce the number of fatalities.

3.9 Greater Jakarta (2017)

3.9.1 City Overview

Jakarta, the capital of the Republic of Indonesia, is of major importance for regional economic activities. Greater Jakarta expands to six cities and three regencies: Jakarta, Bogor, Depok, Tangerang, Bekasi, Tangerang Selatan, Bekasi Regency, Tangerang Regency and Bogor Regency. The population is more than 30 million and has an average density of 4,461 persons/km^2. High housing prices in the central area have forced middle- and lower-income people to live along the urban fringes, consequently requiring long-distance commutes to work.

While the share of private vehicles in urban areas has grown significantly, the share of public transport decreases every year.

In 2000, the share of public transport was 58 per cent and thereafter significantly decreased to 28 per cent in 2010. It is expected to increase after construction of MRT and LRT. Official data shows that private cars and motorcycle ownership grew at an annual rate of 12 per cent. Subsequently, Jakarta suffered from an annual economic loss of 46 trillion IDR (3.8 billion EUR), due to transport congestion.

Jakarta has two kinds of rapid transit system: Transjakarta BRT and Commuter Rail (KRL). The Transjakarta has 13 trunk corridors that use articulated buses and single buses. At particular corridors, the headway of the bus reaches 5-10 minutes per bus. On the other hand, KRL has six loop lines with electric trains and has a service headway of 5-20 minutes per train. According to SITRAMP (2011), the average commuter travel time was 30.2 minutes, while the average travel time on public transport for commuters was above 60 minutes.

Figure 3.28 Greater Jakarta Map

Figure 3.29 Land Use distribution - Greater Jakarta

TransJakarta BRT

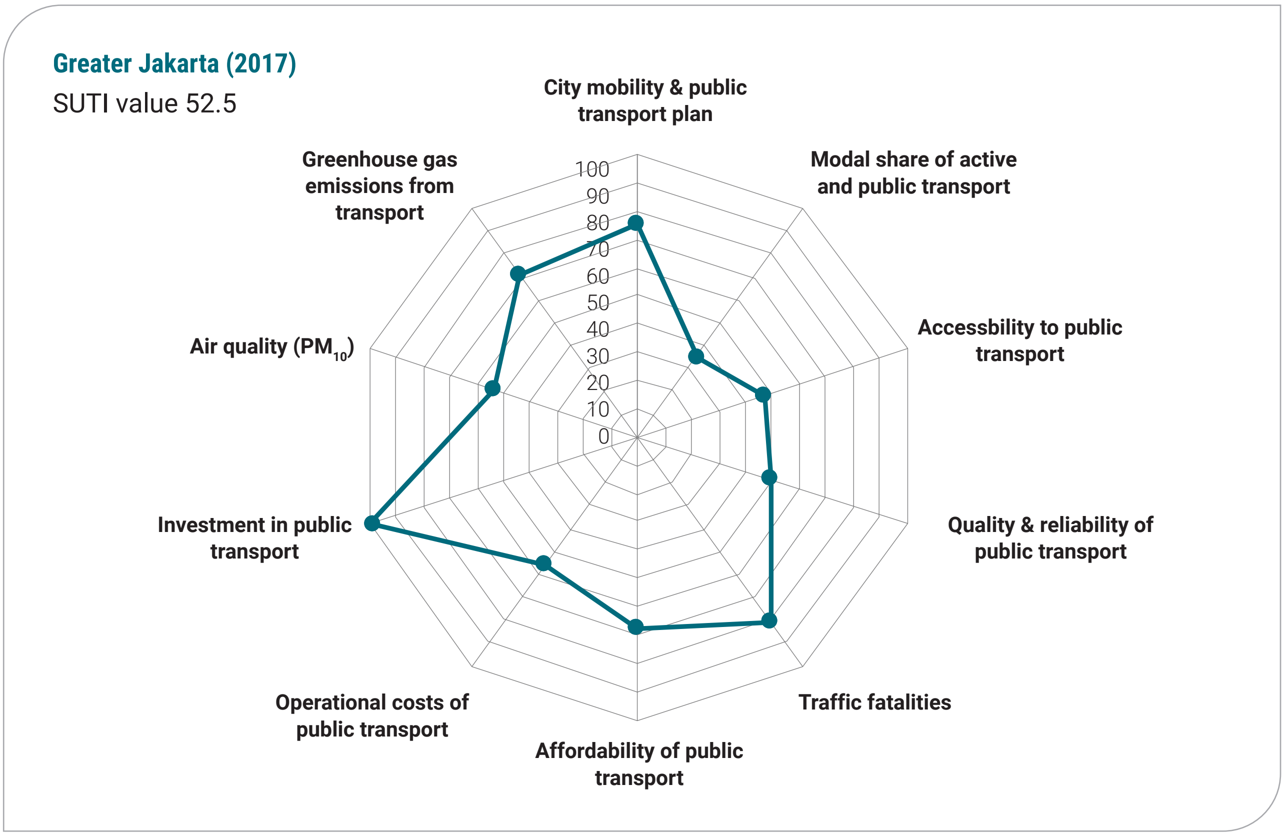
Commuter Rail - KRL

3.9.2 SUTI Results

The aggregate SUTI score for Greater Jakarta is 52.55.

In Jakarta, the modal share of public and active transport is low (27 per cent), and access to public transport services is also relatively poor (49 per cent of population). The public transport quality and reliability performance is low (62 per cent satisfied passengers). In addition, the city has poor air quality (PM_{10} – 75 µg/m^3) and the per capita GHG emissions in the city are low (0.79 tons/annum).

Figure 3.30 Jakarta SUTI Spider Diagram



According to the data collected for the SUTI assessment, traffic safety indicator recorded only 2 fatalities per 100,000 inhabitants, which is unlikely to be accurate. Low-income groups spend an average of 18 per cent of their income on transport. The public transport operator recovers 55 per cent of the cost of operations. During the last five years, the city has been investing considerably in the development of the public transport system (62.3 per cent of total transport investment).

Rencana Induk Transportasi Jabodetabek (RITJ) or the Greater Jakarta Transport Masterplan by Greater Jakarta Transport Authority has short- and long-term strategies for developing sustainable mobility in the city.

3.9.3 Future perspectives

The SUTI assessment of Greater Jakarta revealed several areas which need improvement. One is the need to increase the mode share of public transport. This may be affected by the construction of the MRT and LRT, some sections of which have been completed. The opening of these mass transit systems will also increase the accessibility of public transport, which was estimated to be 49 per cent. Paratransit (Angkots) plays an important role in providing affordable public transport in Greater Jakarta. In addition, a shift towards the use of renewable energy in public transport will help to improve air quality and reduce GHG emissions from transport. The collection and availability of data for indicators has been a challenge.

After the COVID-19 pandemic, there have been efforts to improve the infrastructure for active mobility. The emergence of app-based public transport modes such as Uber, Grab and Ojek (motorcycle taxi) has impacted public transport services. The Greater Jakarta Transport Authority is leading the coordination of efforts to improve urban public transport in Greater Jakarta.

3.10 Jaipur (2019)

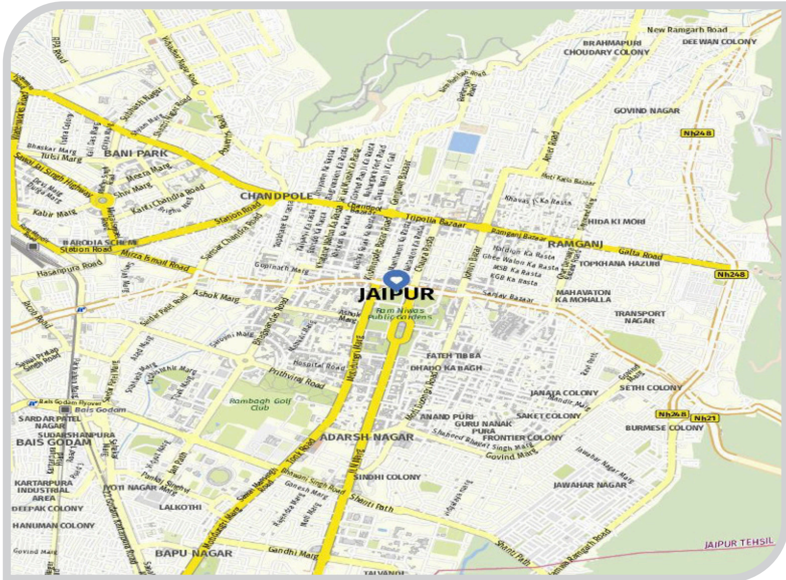
3.10.1 City Overview

Jaipur, the capital city of the state of Rajasthan, India, has a population of 3.4 million (Census 2011) and is spread over 467 km^2. It is the 10th largest city in India. Jaipur city is subdivided into eight geographical zones, 91 wards. Education, commerce and tourism are the main drivers of economic growth of the city. Due to its historical significance and defining architecture, it is one of the most popular tourist attractions in India. Because of its high concentration of economic activities, the walled city has a very high population density, exceeding 75,000 inhabitants per km^2.

Jaipur's land use consists of residential (54.4 per cent), commercial (11.8 per cent) and transport (10 per cent). The road network has been developed in a hierarchical gridiron pattern, consisting of ten radial and three circular roads, with a heavy focus towards the central area, popularly known as the walled city. Jaipur's city road network consists of 2500 km of roads. A plan for a 144 km ring road in the periphery of the city centre has the potential to enhance connectivity in the region. Footpaths exist over a running length of 210 km, which is about a tenth of the total road length in Jaipur city.

In 2018, the total trips within the study area were 3.25 million trips per day, with an average home-based trip length of 8.7 km. Jaipur had 2,791,139 registered vehicles in 2017, which made up almost 19 per cent

Figure 3.31 Jaipur City Map



of the total registered vehicles in the state of Rajasthan. Vehicle density in Jaipur was 25,048 vehicles per km^2, five times higher than for the entire state at 4,299 vehicles per km^2. Two wheelers and private cars hold a high share (83 per cent) of the registered vehicles in Jaipur.

Jaipur City Transport Services Limited (JCTSL) operates a Bus Rapid Transit System (BRTS) on a stretch of 6.6 km between Sikar and Pani Petch. Public bus transport in Jaipur City is provided by a fleet of 400 low-floor city buses operated by the Jaipur City Transport Services Limited (JCTSL) on 32 routes, covering 143 bus stops throughout the city and satellite towns. Ten routes have been defined as high traffic density routes. A fleet of about 55 minibuses owned by private operators also provide public transport facility on the major routes.

Jaipur Metro Rail Corporation (JMRC) provides metro rail lines along two major routes covering 11 metro stations. The city plans to create a comprehensive mobility corridor to integrate all three modes: road, rail and non-motorised transport.

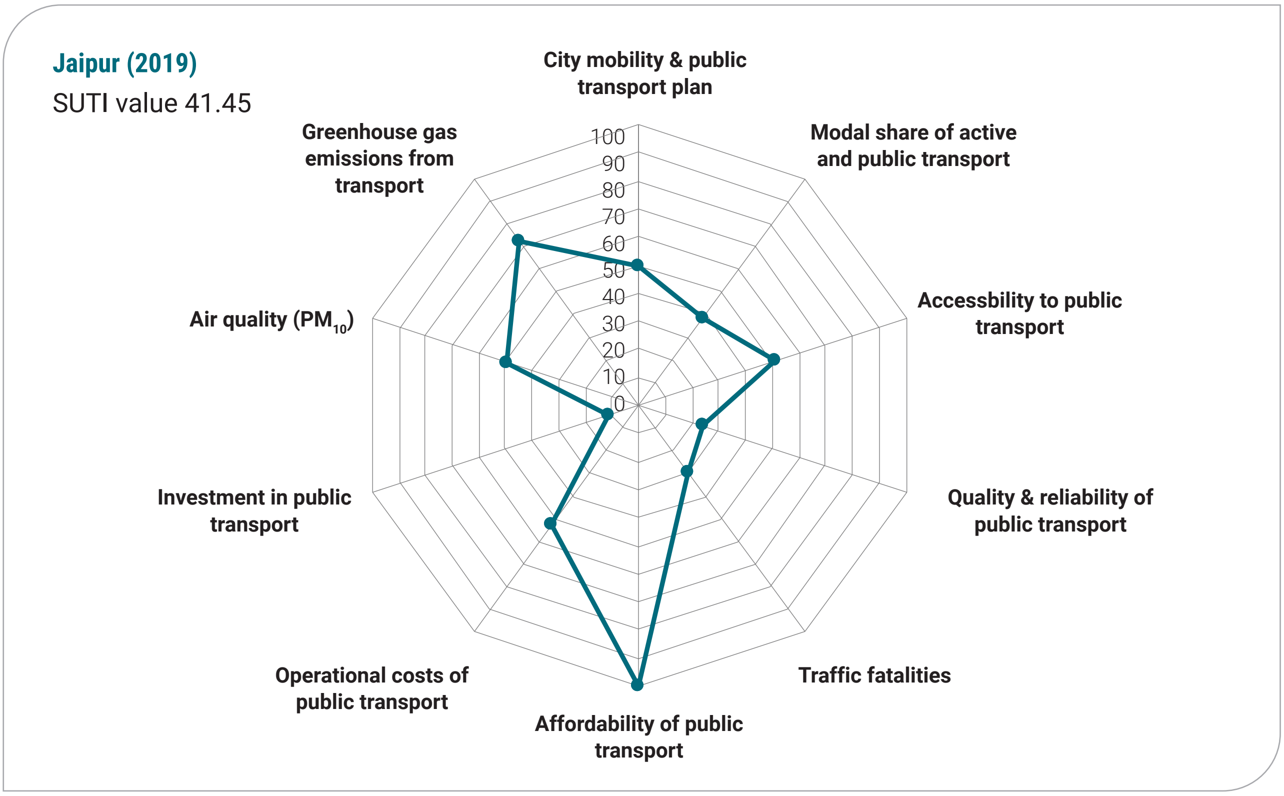
Figure 3.32 Public transport in Jaipur

3.10.2 SUTI Results

The aggregate SUTI score for Jaipur[36] is 41.45.

In Jaipur, traffic fatalities are very high at 25 fatalities per 100,000 inhabitants. During the last five years, the city has been investing minimally in the development of the public transport system (5.8 per cent of total transport investment). The quality and reliability of public transport is moderate, with only 45.5 per cent satisfied passengers.

Figure 3.33 Jaipur SUTI Spider Diagram



The people of Jaipur are moderately dependent on buses, railways, cycling and walking for their mobility needs (mode share – 41 per cent). Public transport access is limited to only 61 per cent of the population. Public transport fares are affordable, with the low-income 20 per cent of the population spending an average of 3.5 per cent of their monthly income on transport. The operators are able to recover only 63 per cent of the operational costs. The inhabitants of the city have moderate air quality (PM_{10} – 80.77 μg/m^3). The per capita GHG emissions in the city are moderate (0.77 tons/annum).

The city developed the Comprehensive Mobility Plan (CMP) in 2018. Besides the CMP, the Master Development Plan (MDP) 2025 also provides the policy framework for the development of the city transportation system.

3.10.3 Future perspectives

The city needs to focus on achieving the targets set as part of its plans by improving in active transport and public transport through increased investments. Measures to reduce the fatality rate urgently need to be taken up by the city. There should also be efforts to improve ridership on metro and public buses.

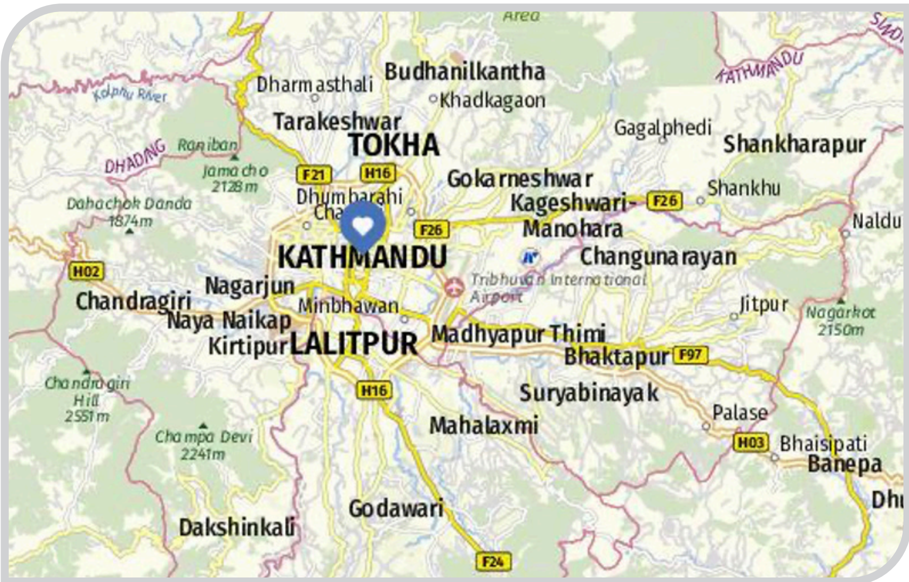
3.11 Kathmandu (2017)

3.11.1 City Overview

Kathmandu, the capital city of Nepal, is located in the Kathmandu valley and the Bagmati zone. The study area covered a total area of 721.87 km^2, including Kathmandu, parts of Lalitpur district, and Bhaktapur district. The total population of Kathmandu Valley in the census year 2011 was 2,517,023 with an annual growth rate of 4.63 per cent. The study area is administratively divided into 2 metropolitan cities and 14 municipalities.

The Kathmandu Valley is dominated by cultivated land, covering about 47 per cent of the total area of the valley. Forested land covers another 251 km^2, accounting for 34 per cent of the total valley area. Regarding land-use, the built-up area consisting of residential area covers more than 14 per cent, but the area under commercial/mixed residential and commercial has been increasing over the past few decades and now covers about 5 per cent of the total area. The Kathmandu Valley, like other urban clusters within Nepal, has a core urban center surrounded by small towns and rural areas, which function as extended urban economic regions.

Figure 3.34 Kathmandu Valley Map



According to the government's "Statistics of Strategic Roads Network (SSRN)" for 2016, the Strategic Road Network (greater than 6 m) for Kathmandu district, Lalitpur district and Bhaktapur district are 247.70 km, 131.39 km, and 115.06 km, respectively. Motorization in the study area has been increasing every year (by 30.41 per cent in 2015/16 and 26.64 per cent in 2016/17).

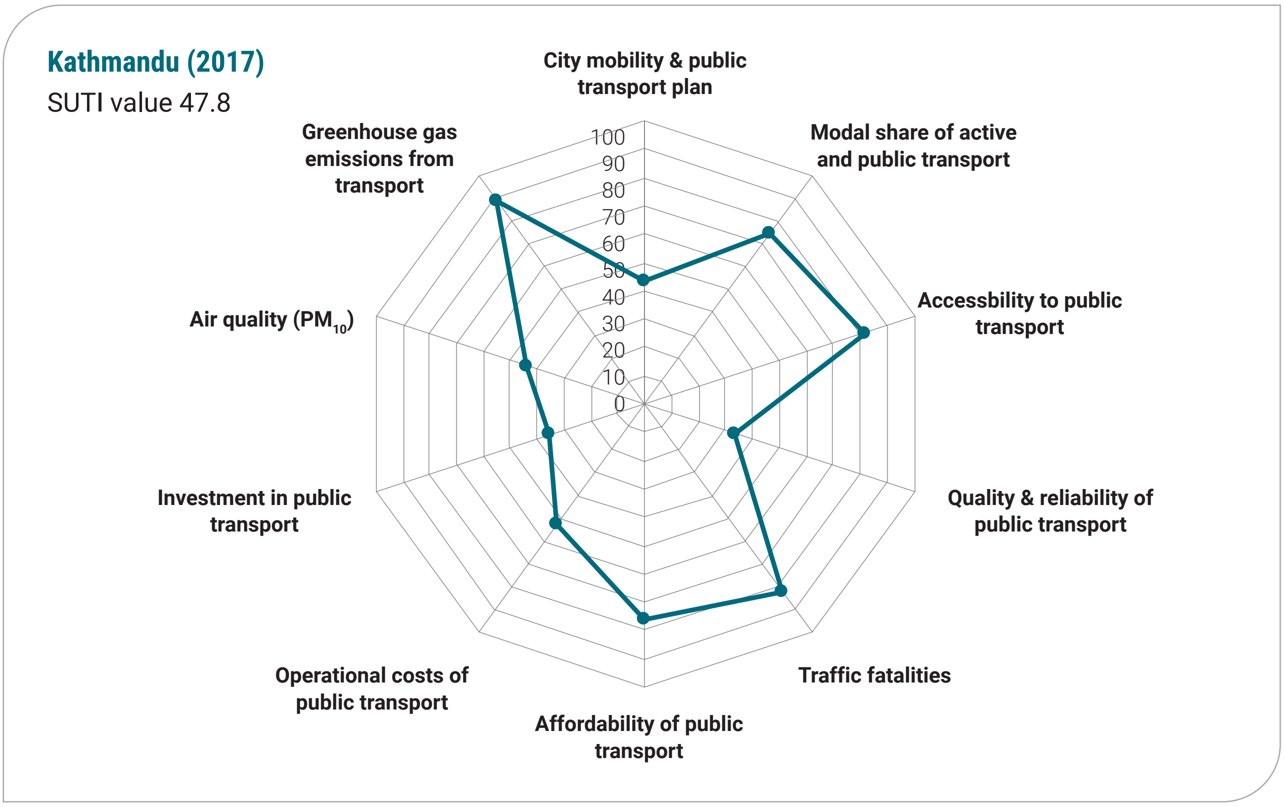
Road transport is the dominant mode of transport. There are no rail-based systems, although several feasibility studies have been conducted. Of the mode split for the study area, 40.7 per cent is represented by walking, 27.6 per cent by buses, 26 per cent by motorcycle, 4.2 per cent by car and 1.5 per cent by bicycle. Popular electric three-wheelers (Safa Temp) operate in many routes to complement bus services. The Kathmandu Sustainable Urban Transport Project (KSUTP) is an initiative of the Ministry of Physical Infrastructure and Transport that aims to improve public transport quality and the pedestrian environment in the Kathmandu valley area. However, the results were mixed, with only some improvements in physical infrastructure. Given the competing interests of the various government authorities involved in urban transport, coordination is still a major issue. There have therefore been calls for the establishment of an authority to plan, develop and manage the urban transport system in Kathmandu Valley, but this has not yet materialized.

3.11.2 SUTI Results

The aggregate SUTI score for Kathmandu is 47.8.

The lack of a comprehensive urban transport plan is a major concern for Kathmandu, despite the fact that many urban transport studies have been conducted. In Kathmandu, the public transport quality and reliability performance is low (only 33.33 per cent satisfied passengers). Traffic safety performance is also low at 6 fatalities per 100,000 inhabitants. During the last five years, the city has invested only 17.84 per cent of total transport investment in the public transport system. The inhabitants of the city experience low air quality (PM_{10} – 88 μg/m^3). The per capita GHG emissions in the city are low (0.31 tons/annum).

Figure 3.35 Kathmandu SUTI Spider Diagram



The modal share of public and active transport is moderate (69.77 per cent), while access to public transport service is relatively high (85 per cent of population). Fares are affordable, as low-income groups spend an average of 11.1 per cent of their income on transport. Public transport is mainly operated by the private sector, and private sector public transport operators are almost at breakeven point to recover the cost of operations.

Figure 3.36 Public transport in Kathmandu

3.11.3 Future perspectives

SUTI provided new insights into ways to improve sustainable mobility in the Kathmandu Valley. Firstly, there is a need to develop and implement a comprehensive urban transport plan for Kathmandu Valley that prioritize facilities for pedestrians and cycling, the development of bus terminals, and a mass transit system. Despite various studies on public transit like metro, BRT and roadways, authorities have not yet decided on a system. Various urban development plans and strategies for sustainable urban mobility developed as part of earlier studies and projects should be implemented on a priority basis by developing short-, medium- and long-term measures to improve public transport.

There is an urgent need to improve the quality and reliability of the public transport system and increase investments in the public transport sector. The popular paratransit (Safa Tempo) also needs need proper stops and support to improve safety. Enforcement of traffic rules and implementation safety action plans would help to reduce the fatality rate in the city.

In order to improve air quality, a greater mode shift to public transport modes should be considered. Recently, electric buses have been added to the fleet operated by both public and private sector. Given the high share of green energy, the city should continue to promote electric mobility and use renewable energy in transport.

Given the challenge of coordinating three layers of government and other agencies in urban transport, there is an urgent need for a central authority to lead and manage the urban public transport sector within the Kathmandu Valley.

3.12 Khulna (2019)

3.12.1 City Overview

Situated in the south-western region of the country, Khulna is the third largest city after Dhaka and Chattogram with a population of 1.5 million. The city has an area of around 45 km^2 and is situated along the river Bhairab. The railway line and National Highway running parallel to the river act as the spine for urban development in the city, with major developments taking place along this alignment. These give the city its linear form. Several major roads were constructed to act as ring roads and together form the arterial road network of the city.

The transportation system in the city is characterized by both public and private transport. Being a small city, the trip distances are small, with an average of 2 km. The public transport of Khulna city is one of the oldest systems in the country. However, since the city does not have proper large-capacity public transport options, the majority of commuters rely on non-motorized modes and paratransit.

The urban transport system of Khulna is mainly road-based. The road density of the city is high, with 1,215 roads covering an area of 356.64 km^2. Though the density of roads is good, pedestrian facilities along these roads are not adequate. As a result, city dwellers often use rickshaw and "Easy Bikes", even for walkable distances. The rickshaw is a standard NMT service that delivers door-to-door travel. Between 2010 and 2019, the majority of these rickshaws added a small motor and automated peddling. However, the Khulna City Corporation (KCC) recently banned all automated rickshaws, and manual rickshaws are reappearing. Three-wheeled four stroke diesel vehicles called Mahindras also operate in parallel with bus routes.

Figure 3.37 Khulna City Map

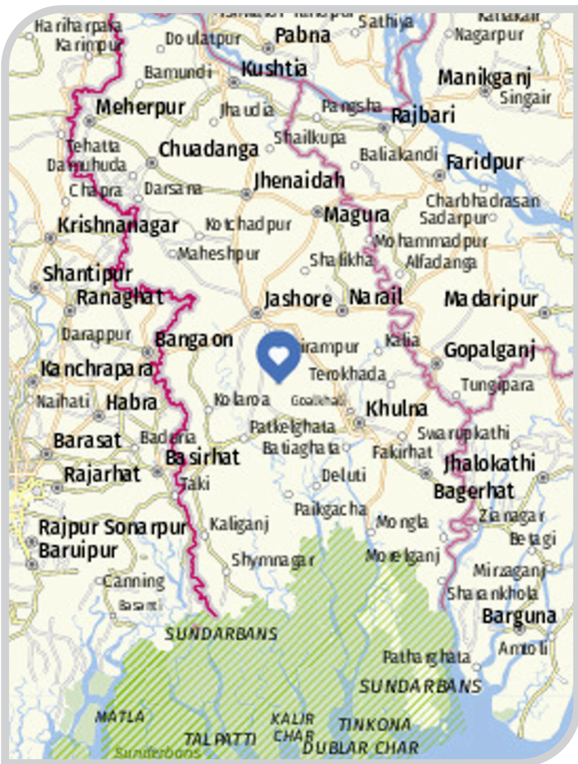


Figure 3.38 Major Transport Modes in Khulna City

City Bus | Easy Bike | Rickshaw | Mahindra

There is a public bus service called "Town Service" which operates from Fultola to Rupsha Ghat (22 km) with ten old buses. However, because of the poor quality of town bus services, commuters often prefer Easy Bikes or Mahindras, although the fare is higher than that of the bus. As a result, traditional high-capacity buses struggle to obtain patronage from commuters. Battery-driven Easy Bikes provide both shared trips on several routes and paratransit for personalized trips. Around 8,700 Easy Bikes ply the roads and are thought to cause traffic issues in the city. The regulation regarding Easy Bike operation is still passive.

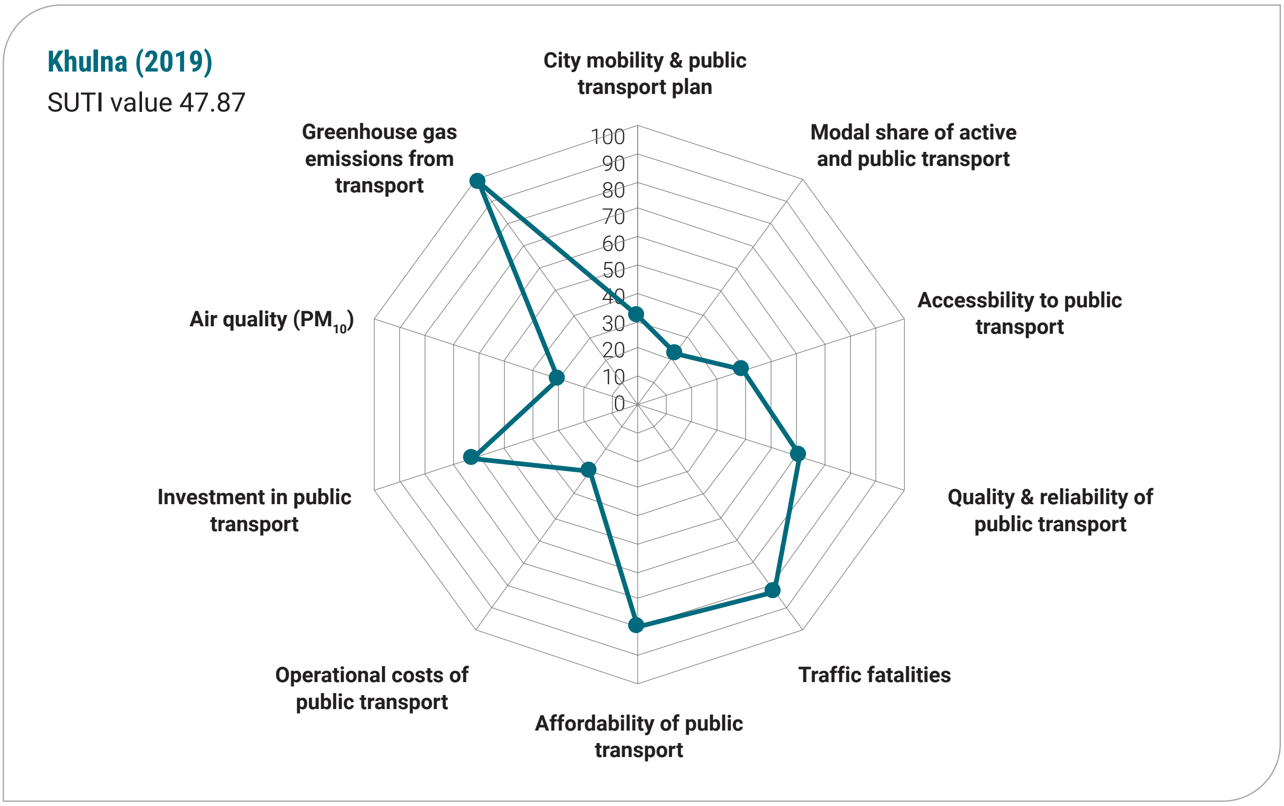
3.12.2 SUTI Results

The aggregate SUTI score for Khulna is 47.87.

The SUTI value for transport planning is poor because Khulna lacks a specific public transport plan. The Master Plan of Khulna city puts very little focus on pedestrian infrastructure and public transport modes; cycling facilities have not been included. The traffic fatality value is relatively low at 1.7 fatalities per 1000 population, and greenhouse gas emissions per capita are low (0.063 tons/annum). On the other hand, the air quality of the city is very poor (annual mean 107 $\mu g/m^3$), but better than the average for the country (150 $\mu g/m^3$).

The city bus accounts for only a 2 per cent share of daily commuting trips. If Easy Bike and Mahindra are considered a part of public transport, the modal share of active and public transport is 86 per cent. Easy Bike accounts for about 37 per cent of the total trips in the city due to its large service coverage. Without Easy Bike and Mahindra, the combined share of public transport and active modes fall to 46.1 per cent. The share of walking is 21 per cent of commuting trips. The city dwellers are quite satisfied with transport quality and reliability (69.55 per cent of people are satisfied). Around 9.95 per cent of the family income is spent on transport purposes in Khulna city, which implies that public transport is affordable for residents.

Figure 3.39 Khulna SUTI Spider Diagram



Public transport accessibility is 88 per cent, with people living within 500 m of public transport stops (if Easy Bike is included); however, if Easy Bike is not included, then it is estimated that only about 52 per cent of the city people have good access to public transport.

3.12.3 Future perspectives

Khulna City needs to work towards a comprehensive public transport plan with a vision to establish an efficient and convenient public transport system. Areas of focus should include infrastructure such as pedestrian and bicycling facilities for active mobility and intermodal transfer stations. There should be efforts to increase the share of public transport and to mobilize investment to improve public transport. Institutional arrangements for developing city-level transport plans and their implementation and management of public transport is necessary.

The accessibility of public transport needs to be increased from 52 per cent by rationalizing public transport and extending routes to wider areas. Given the importance of Easy Bikes and Mahindras in providing public transport service, authorities should facilitate their operation by proving designated stops and rationalizing routes. The battery-operated Easy Bikes can pave the way for transiting to electric mobility for paratransit, which would contribute to emission reductions to some extent. In the meantime, the old fleet of public buses needs to be modernized. The fare revision to ensure operation sustainability of buses as well as to attract more commuters is needed.

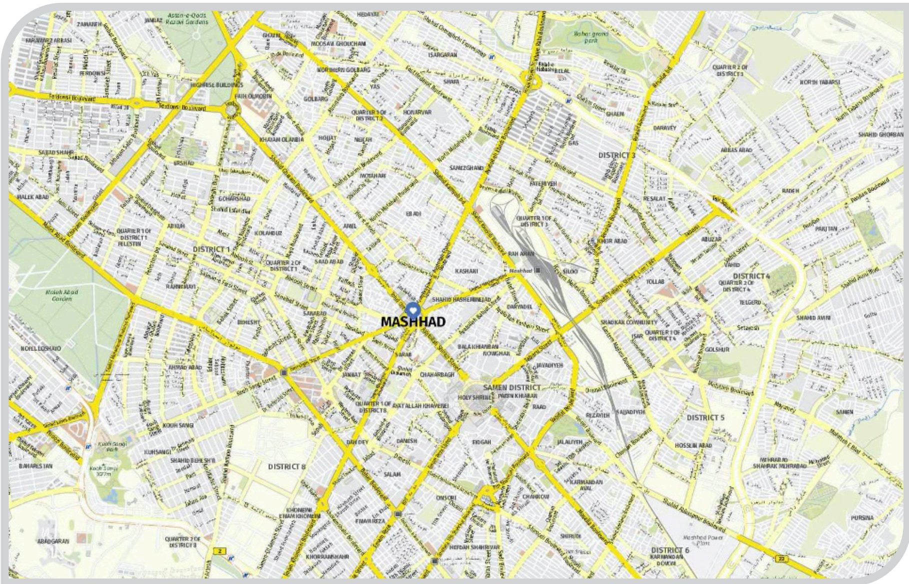
The traffic fatality rate is relatively low compared to other cities in the country. Per capita GHG emissions are also relatively low, mainly because the number of industries is very low in the city and there are few buses which run on fossil fuel. By enhancing the overall quality and provision of public transport and improving facilities for active transport, Khulna can remain a good place for living and economic growth.

3.13 Mashhad (2021)

3.13.1 City Overview

Mashhad is located in the northeast of the country and is the capital of the Razavi Khorasan Province. With a population of 3.25 million people, it is the second most populous city in the Islamic Republic of Iran. The city density is 9,000 people per km^2. As Mashhad is a major destination for pilgrims, large numbers of people visit the city every year. The city has expanded radially around two centres: the holy shrine of Imam Reza (pbuh), the eighth Shia Imam, and another square near the holy shrine. Mashhad is divided into 13 municipal districts and features a wide network of urban highways and expressways, arterial and major streets, collection and distribution streets, and local streets. The zone around the holy shrine is a traffic congestion zone of 7 km^2 where an even-odd license number scheme is in operation.

Figure 3.40 Mashhad City Map



While the rate of motorization has increased significantly in recent years, car ownership is relatively low with only 319 private cars for every one thousand people. The total number of daily motorized trips in the city is more than 6.5 million, including motorcycles and public transport. Mashhad benefits from a variety of public transport systems, including buses, LRT, minibuses, and taxis. Most of the public transport is undertaken by the bus network, with 110 lines across the city. In addition to regular buses, there are two BRT routes for high-demand corridors and 26 minibus lines for low-demand ones. Daily ridership of the bus system and BRT lines are 81,672 and 179,773 passengers, respectively. The private sector owns 48 out of 134 bus lines (36 per cent), while carrying 62 per cent of passengers. After buses and LRT, taxis are the most common mode of public transportation in Mashhad. Taxis in Mashhad include online taxis, local taxi agencies, hail service taxis and fixed route taxis. In recent years, online taxis have attracted a significant share of trips due to their reasonable costs, ease of access and transparency in pricing.

Due to the easy slopes of most streets and its steppe climate, Mashhad is conducive to cycling. Dedicated bicycle lanes have been set up on the wider streets, but their lack of connectivity and lack of a comprehensive action plan to facilitate cycling are obstacles for further growth in bicycle trips.

An important development is the Imam Reza (pbuh) multimodal passenger terminal, also called the central terminal, which includes intracity bus terminal, intercity bus terminal, LRT line 3 station and taxi bay. The terminal has access to the Kalantary Highway from the south and is connected to residential areas and urban streets in the north.

The management of freight and passenger transport within the city and its suburbs is the responsibility of the municipality. Transport services are coordinated by the Municipality Transportation Deputy and managed by specialized organizations, including the Bus Organization of Mashhad; Taxi Organization of Mashhad; Traffic and Transportation Organization of Mashhad; Urban & Suburban Freight Transportation Management Organization of Mashhad; Passenger Terminal Organization of Mashhad; Mashhad Urban Railway Corporation; and the Mashhad Urban Railway Operation Company.

Figure 3.41 Public transport modes in Mashhad

To promote gender equality, Mashhad provides opportunities for women in both service delivery and utilization of services in city buses. Almost half of the area inside buses are reserved for women, and men are not allowed to enter them. Meanwhile, the beginning and end of LRT trains are reserved exclusively for women. By providing elevators in city train stations, special consideration is given to other users, such as the elderly, people with disabilities, mothers with prams and people in wheelchairs. In the bus sector, the new fleet is without stairs so that people with disabilities, in wheelchairs and pushing baby strollers can get on the bus. Further efforts are underway to make transport more inclusive.

Mashhad Municipality uses various technologies and policies for road network management, integrated payment system (bus/LRT), e-payment in taxis using mobile apps, GPS equipped bus fleets, congestion charging, and intersection traffic signal integrated management system (SCATS) to enhance efficiency of operation. In 2021, Mashhad also unveiled the first domestically produced electric bus, with more planned for production.

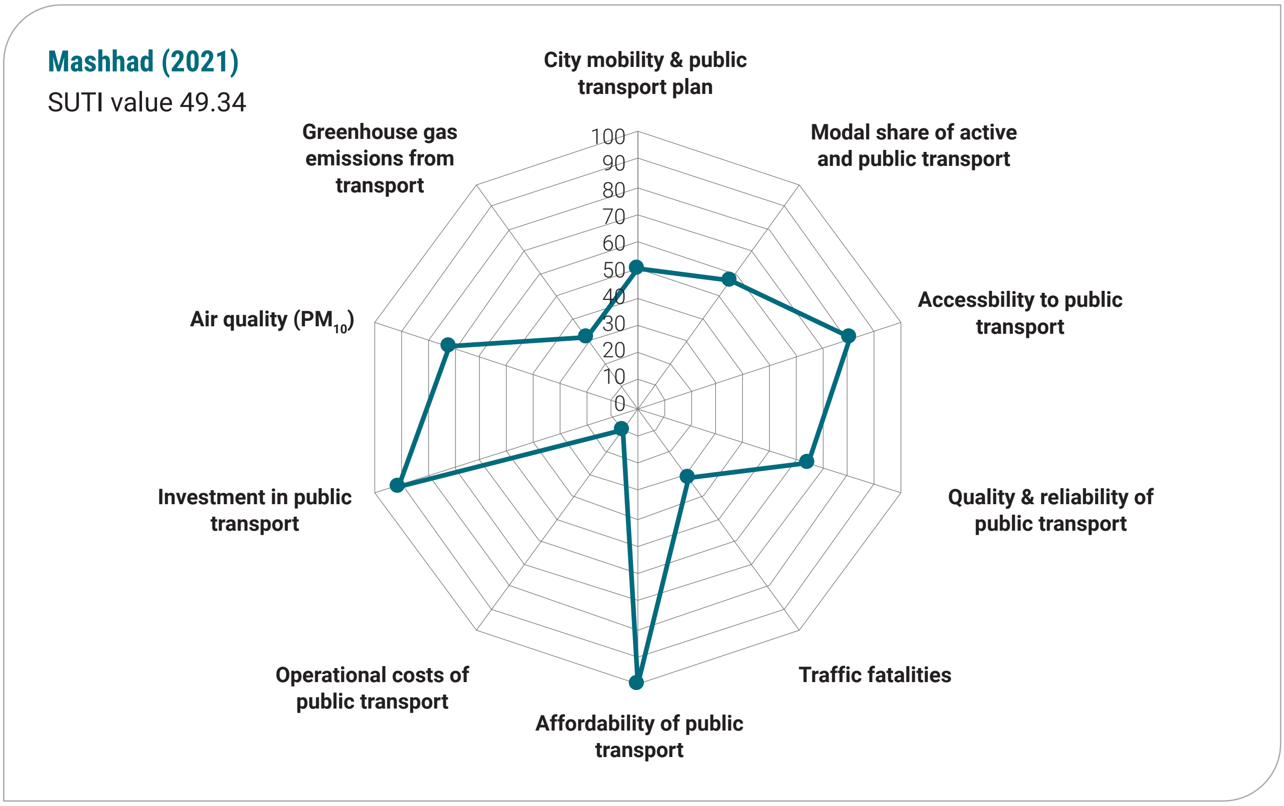
3.13.2 SUTI Results

The overall Mashhad[39] aggregate SUTI Value is 49.34

The assessment found that Mashhad citizens benefit from affordable and highly accessible public transportation with 85 per cent coverage. The mode share of active and public transport is 55 per cent. The cost of transportation is on average only 3.2 per cent of the income of urban households. This is due to the fact that the bus and LRT fares are proposed by the municipality and approved by the city council on an annual basis. The city performed relatively well in terms of investment in public transport, with 46 per cent of transport investment for public transport.

For the environmental and social indicators, the city performed fairly well on air quality but poorly on GHG emissions and traffic safety. The PM_{10} value was 50 micrograms per cubic meter. Meanwhile, it is estimated that per capita GHG emissions are around 1.89. With regard to road safety, there are 6.9 fatalities per 100,000 inhabitants, which is relatively high compared to other cities in the world. Pedestrians have proven to be particularly vulnerable in the streets of Mashhad and make up a substantial proportion of casualties.

Figure 3.42 SUTI Diagram for Mashhad



3.13.3 Future perspectives

The SUTI analysis highlighted the following points to enhance overall sustainability of public transport in Mashhad.

Urban transport planning needs to secure financial resources, mostly from the city budget, in order to be able to achieve development targets. The quality and reliability of the city's public transport system can be improved through better integration of modes. Quality of services can also be improved by providing information about public transport network services to passengers. Furthermore, more attention should be paid to expanding public transport coverage in the border areas, which have less services than in central Mashhad.

Public transport costs are low compared to people's incomes. Low fare prices are attractive for users, but require the local and central government to provide subsidies. Authorities could consider revising the public transport fare so that operators can increase the quality of public transport services while maintaining economic stability.

Renewal of the bus fleet will improve the service quality of public bus services. The renovation of city buses fleet can also reduce air pollution. The electrification of the bus fleet is having a positive impact and should continue at a faster pace. Providing incentives for active and public transport may also attract more users.

Road safety is a serious social and economic issue for the city. A road safety action plan with short-term and long-term measures is necessary to enhance safety. Meanwhile, women's access to public transportation is very good. The dedicated wagons in the LRT and the dedicated sections in buses provided a secure place for women to travel.

3.14 Metro Manila (2021)

3.14.1 City Overview

Metropolitan Manila, also known as the National Capital Region (NCR), is the economic, political and educational centre of the Philippines. With a population of 13.5 million, it is the second most populated region in the country. Administratively, Metro Manila is subdivided into 4 districts which is composed of 17 Local Government Units (LGUs) (16 cities and 1 municipality), which in turn are made up of a total of 1,705 barangays.

Figure 3.43 Metro Manila Map

The number of motor vehicles registered in Metro Manila increased by 38 per cent between 2014 to 2019. Improvements in the economy and rise in population along with the slow pace of infrastructure development has resulted in severe traffic congestion. In 2019, the TomTom traffic index ranked Metro Manila as the second most congested city worldwide. Metro Manila's road network spans almost 1,200 km, and is classified into primary (169 km), secondary (395 km) and tertiary (600 km) roads. To help curb congestion, the Metro Manila Development Authority (MMDA) implemented the Unified Vehicular Volume Reduction Program Regulating the Operation of Certain Motor Vehicles on Roads in Metropolitan Manila (UVVRP) or "Number Coding Scheme", which controls vehicles from operating in the city from 7:00 AM to 8:00 PM depending on the last digit of their plate numbers. This policy is believed to have had some impact, but the goals of the policy have been undermined by the fact that some residents have resorted to buying additional cars.

Public transportation in Metro Manila is relatively unique in the sense that it is largely operated by the private sector, with the majority of services run by small to medium-scale operators. Most services, such as buses and jeepneys, have fixed routes and a well-defined fare structure. Last-mile connectivity is served by tricycles which are managed by LGUs. The most dominant type of Public Utility Vehicle (PUV) is the Public Utility Jeepney (PUJ) with more than 42,043 units, followed by UV Express at 10,956, and city buses at 4,803 units (as of February 2020). However, due to public transport's low capacity and level of service, Transport Network Vehicle Services (TNVS) such as Grab Car and motorcycle-based ride-hailing platforms have gained popularity over the years.

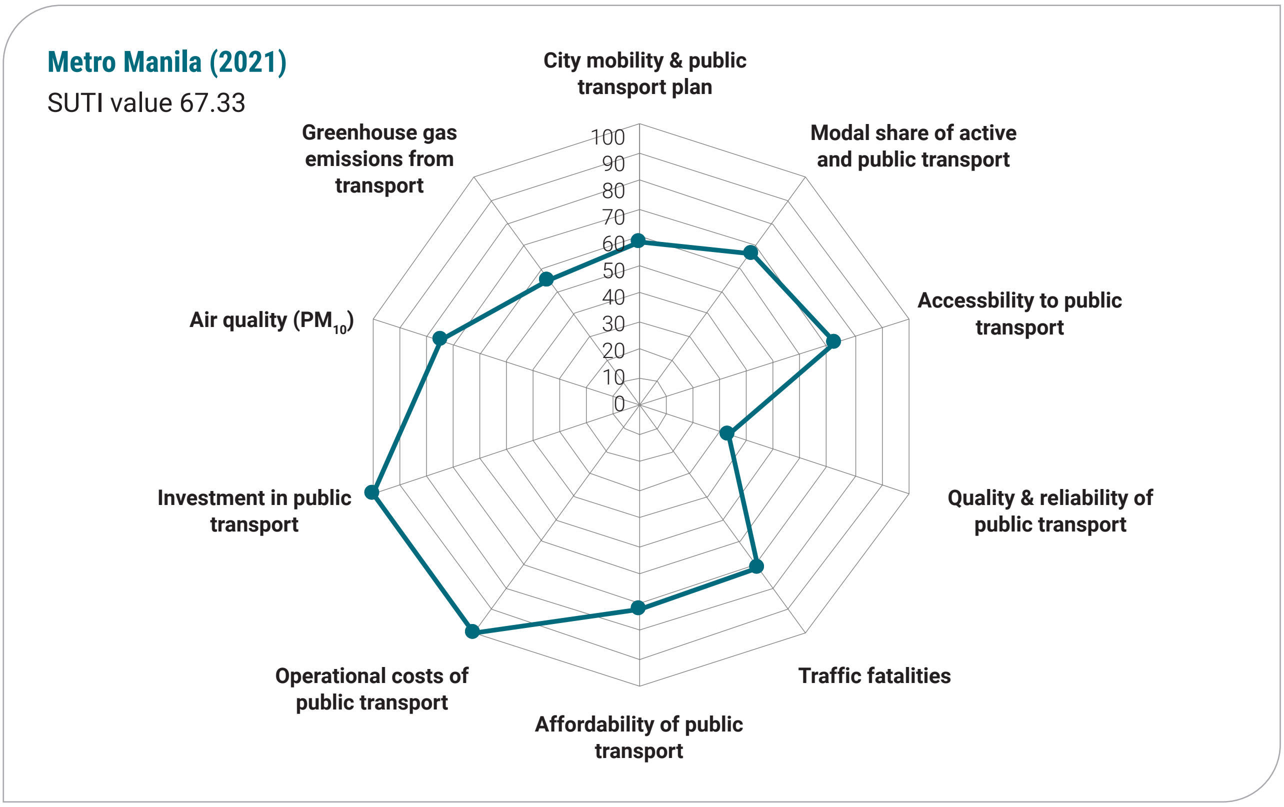
Recognizing the need for enhanced coordination in traffic enforcement between agencies and LGUs, the Inter-Agency Council for Traffic (i-ACT) was re-launched in September 2017 to coordinate solutions to traffic situations in the Philippines. This council, which is comprised of the key transport-related agencies both within the city and in neighbouring provinces, aims to unify all traffic management operations including manpower, resources, equipment and infrastructures under a unified chain of command. Meanwhile, the administration of President Duterte launched the "Build, Build, Build" program in 2016 which was expected to usher in the "Golden Age of Infrastructure".

Figure 3.44 Transport modes in Manila

3.14.2 SUTI Results

The SUTI score of 67.33 for Metro Manila[40] is relatively good. However, many infrastructural investments and policies on public transport still need to be materialized.

Figure 3.45 Spider diagram Metro Manila



Metro Manila has been the focus of several master planning efforts. As the capital of the country, a significant portion of government resources have been poured into its transport system. Public transport and intermodal facilities have been prioritized and funded mostly by the national government, with large investments on railways and integrated terminals. Plans for walking and cycling infrastructure before the COVID-19 pandemic were limited to specific corridors only, but as a result of the pandemic, more extensive active transport networks have been introduced. The city performed well on investment in public transport, with significant funding allocated for hard infrastructure such as railways and intermodal terminals.

The mode share of active and public transport is relatively high compared to other Asian cities with 63.7 per cent (excluding paratransit modes). However, the rise in motorcycle use may threaten the share of public transport. The high public transport usage is related to both the accessibility of 77.71 per cent and the affordability of the services.

However, this does not necessarily translate to a convenient trip since trip-chaining and transferring behavior were not accounted for in the analysis. Furthermore, there is a high dissatisfaction for punctuality, which also imposes an economic cost on users. The city fared poorly on public transport quality and reliability. There was an overall low satisfaction for various aspects of public transport, especially for level of service criteria such as punctuality, comfort and cleanliness, safety, and availability of information.

The majority of private sector operated PUVs such as buses and jeepneys are generally profitable. This is because they operate relatively small fleets and hence require smaller capital costs. They are also cheaper because of low-cost maintenance practices and safety issues. However, railway lines have low farebox ratios and are therefore heavily subsidized by the government.

Road traffic safety with 2.9 fatalities per 100,000 inhabitants is moderate, but not close to the goal of achieving zero road traffic deaths by year 2022 as stated in the Philippine Road Safety Action Plan. The estimated GHG emission levels are on the high side (54.93 per cent normalized value). The majority of vehicles are still using petrol and diesel, with cleaner fuels and associated vehicles not yet gaining critical mass. Although the city has greatly improved its air quality, the weighted PM_{10} concentration in Metro Manila is still above the WHO's target reduction rate for reducing air pollution-related deaths.

3.14.3 Future perspectives

The SUTI analysis has highlighted the following points:

Metro Manila features many essential factors to achieve more sustainable urban mobilities, such as a high share of public transport mode, sizeable investments in public transport, good coverage and convenient access to public transport with efforts to improve the integration of modes and transfer facilities. However, a more comprehensive plan to achieve seamless transfers among modes and feeder lines should be developed.

There is a need to further improve public transport quality and reliability to counter the popularity of ride-hailing and motorcycles. A more transparent and institutionalized feedback mechanism for determining service quality and satisfaction levels should be considered to measure if the intended transport experience is felt by users.

The transport sector is partly responsible for the poor air quality and high GHG emission levels. Some of these issues are being addressed by the PUV Modernization program. This program should be continued, especially route rationalization, keeping in mind the economic costs to public transport users. Meanwhile, the promotion of cleaner vehicles both from the supply and demand side should be accelerated.

The COVID-19 pandemic has caused significant impacts to transport. The quarantine brought opportunities to improve urban mobility such as the heightened focus on active transport, the commencement of service contracting for PUVs, and the provision of priority lanes for buses. The concept of "sharing the road" and veering away from car-centric thinking is also gaining more interest from civil society organizations, the academe, and government, among others. There should be support for walking and cycling infrastructure that focuses on connectivity and integration with public transport, as well as support for low carbon technologies such as electric mobility.

3.15 Palembang (2020)

3.15.1 City Overview

Palembang is the capital city of South Sumatra Province, Indonesia. The administrative area of the Palembang Municipality is divided into 18 subdistricts and 107 villages. In 2019, the population was 1,662,893 people. In the same year, the three sectors that contributed most to the economy were the manufacturing industry (31.28 per cent), followed by construction (17.90 per cent), and wholesale and retail trade (17.50 per cent). The economic growth rate of the city has decreased from 8.53 per cent in 2012 to 7.12 per cent in 2018.

The total length of all roads in Palembang Municipality was 681 km (as of 2019). The increase in road length from 2017 to 2018 was about 0.15 per cent. Motorcycles dominate the vehicle population with 664 units per 1000 population. The number of passenger cars per thousand population was 141 units, while the number of public transport vehicles per 1000 population was only 1 unit.

The total number of trips in Palembang City (2019) was 1,754,916 per day. The mode share for work trips was 47.66 per cent private motorcycles, 16.15 per cent private cars, 12.5 per cent online motorbike taxi and 10.16 per cent public transportation. At present there are five Trans Musi bus corridors and fourteen urban transportation routes serving the city center and suburbs of Palembang City. There are 73 buses with a passenger capacity of 34 people or 59 people. The existing Light Rail Transit (LRT) line has a length of 23.4 km.

Figure 3.46 Palembang Ciy Map

Figure 3.47 Palembang – Public Transport System

3.15.2 SUTI Results

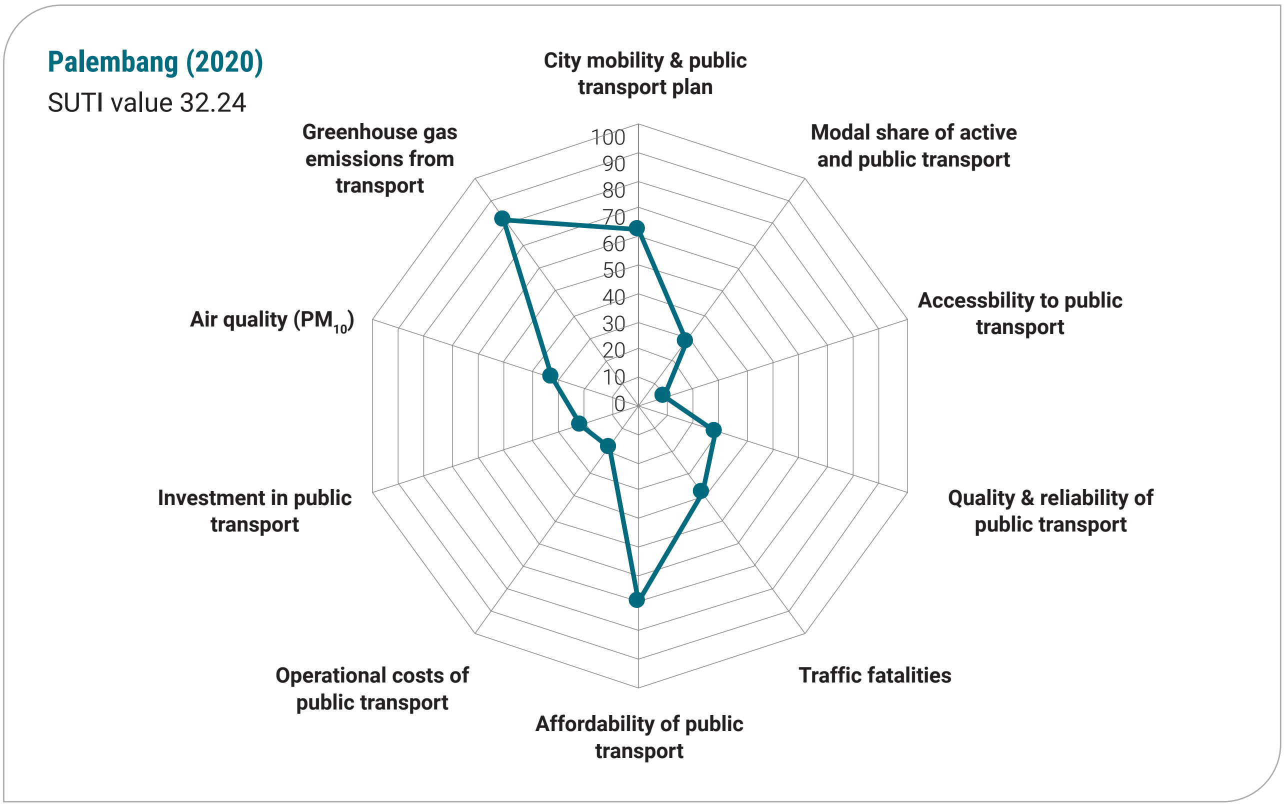
The aggregate SUTI score for Palembang[41] is 32.24.

During the last five years, the city has been investing only a small amount into developing the public transport system (1.4 per cent of total transport investment). Public transport access is limited to only 30.4 per cent of the population. Furthermore, the inhabitants of the city have poor air quality (PM_{10} – 104 µg/m^3).

The people of Palembang are predominantly dependent on motorcycles for meeting their mobility needs, and the share of public transport and active transport in mode share is relatively low (32.6 per cent). The quality and reliability of public transport is moderate (48.8 per cent satisfied passengers) and the level of traffic fatalities (6 fatalities per 100,000 inhabitants) is also fairly moderate. Public transport fares are good, with the bottom 20 per cent of the population spending an average of 13.2 per cent of their monthly income on transport. However, transport operators recover only 49.2 per cent of the operations costs. The per capita GHG emissions in the city are moderate (0.51 tons/annum).

The city has developed ambitious goals under the RTRW Palembang City (2012-2032).

Figure 3.48 Palembang SUTI Spider Diagram



3.15.3 Future perspectives

SUTI provided new insights into the areas of focus for Palembang city, Indonesia. These include the need to increase investment in public transport, infrastructure for cycle tracks, pedestrian facilities, sidewalks, and bus stops. The accessibility of the public transport system can be improved by increasing the number of bus stops in densely populated areas and the frequency of service and operational time of Trans Musi.

To increase the mode share of public transport, the fleet of Trans Musi can be increased to improve punctuality and better information on public transport services should be provided through audio or visual means at bus stops. To improve traffic safety, educational campaigns and safety education should be proactively given, while the number of traffic signs at accident-prone points should be increased. More strenuous enforcement of regulations to prohibit the operation of vehicles that are not maintained and cause air pollution will improve air quality.

3.16 Pekanbaru (2020)

3.16.1 City Overview

Pekanbaru is the capital of Riau Province, located 950 km northwest of Jakarta. Pekanbaru city covers an area of 632.26 km^2 and is divided into 12 districts. The Rencana Tata Ruang Wilayah (RTRW), or spatial plan, of Pekanbaru City is a document which provides a strategy and policy directive on the use of national and island areas. Based on the data of the Pekanbaru City Statistic Central Agency, the population of the city in 2019 was 1,149,359, with a population growth rate of 4.2 per cent. The city has a density of 1,818 inhabitants per km^2.

The economic structure of the city is dominated by wholesale and retail trade, repair of vehicle and motorcycle (31.41 per cent), construction (30.16 per cent), and manufacturing (19.24 per cent). The economic growth rate of the city increased from 5.7 per cent in 2016 to 6 per cent in 2019. In 2019, the length of the road network was 1,277.9 km. It consists of national roads (83.45 km), provincial roads (127.51 km), and city roads (1,066.94 km).

The primary means of public transportation in Pekanbaru is a BRT system called TMP (Trans Metro Pekanbaru). There are also minibuses, called *oplet*, which operate in the city. They are privately operated and relatively cheap, serving multiple routes throughout the city. Three-wheel motorcycles are also used in some areas as public transportation. While *ojeks* (motorcycles) are commonly used in remote areas of the city, taxis and online transport such as Gojek and Grab are also widely available. TMP has 260 bus stops along corridors of about 104 km length, with an average bus stop distance of 800 m.

Figure 3.49 Pekanbaru City Map

Figure 3.50 Pekanbaru – Public Transport System

3.16.2 SUTI Results

The aggregate SUTI score for Pekanbaru[42] is 61.32.

The city has ambitious goals under the spatial plan (RTRW) of Pekanbaru City (2019-2039). However, the mode share of active and public transport in commuting is low at 35 per cent, and currently the residents of Pekanbaru are largely dependent on motorcycles to meet their mobility needs. Access to public transport is limited to only 50.3 per cent of the population. The investment in public transport systems is low at 25 per cent of transport investment.

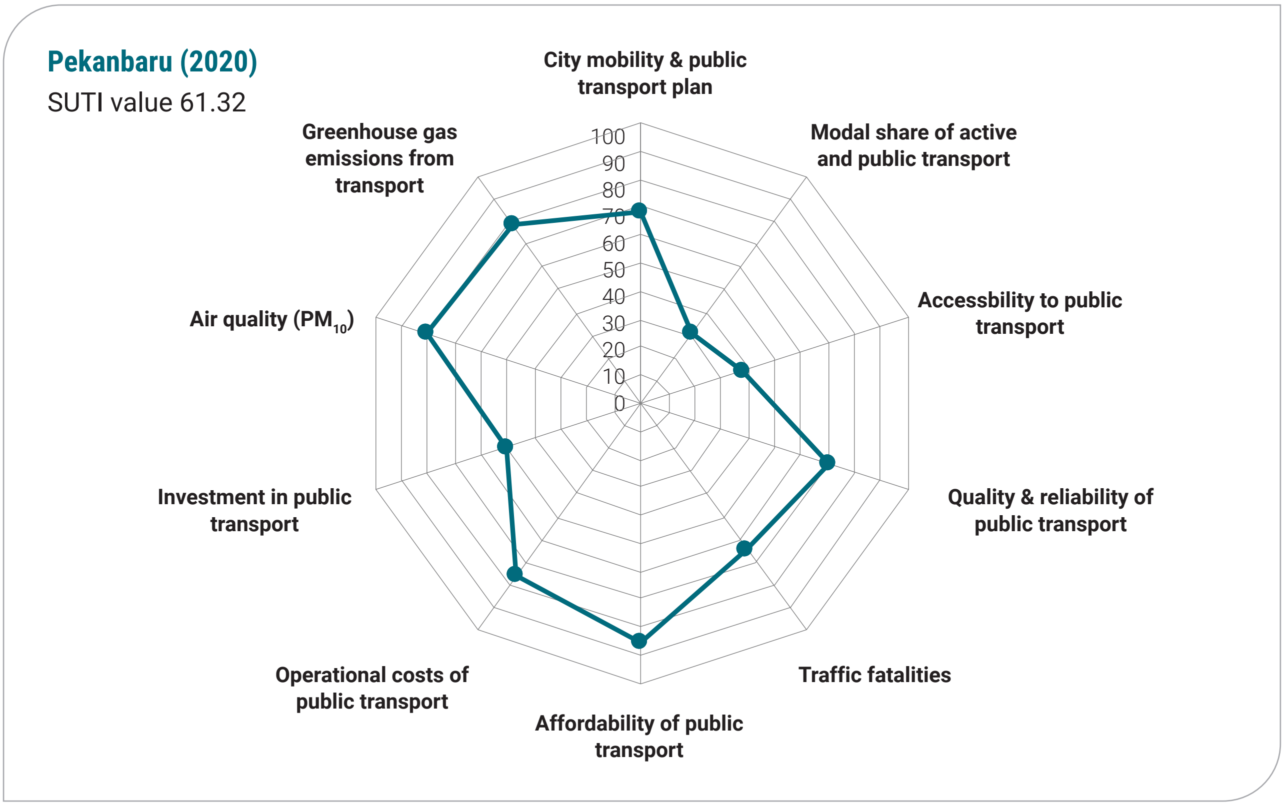
The quality and reliability of public transport is good (75.6 per cent satisfied passengers). The traffic fatalities (4 fatalities per 100,000 inhabitants) is moderate. Public transport fares are good, with the bottom 20 per cent of the population spending an average of 8 per cent of their monthly income on transport. The operators recover 66.1 per cent of the operations costs. During the last five years, the city has been investing moderately in the development of the public transport system (25.3 per cent of total transport investment). The inhabitants of the city have moderate air quality (PM_{10} – 38 µg/m^3). The per capita GHG emission in the city is also moderate (0.59 tons/annum).

The service times of the public transport system were restricted during the COVID-19 pandemic. There was a decrease in passenger volume (only 16.7 per cent of normal conditions) with reduced bus frequencies (28 per cent of normal conditions) and reduced vehicle numbers (40 per cent of normal condition) in 2020. The public transport operators had to bear higher operational costs to comply with health protocols and reduced passenger volumes.

3.16.3 Future perspectives

To improve its SUTI assessment scores, Pekanbaru city needs to make policy efforts to increase the modal share of public transport and active mobility through defined strategies and dedicated allocation of funds, as well as by increasing the accessibility of public transport services for the wider population. In order to decarbonize public transport, the use of renewable energy and biofuels in BRT TMP buses needs to be encouraged.

Figure 3.51 Pekanbaru SUTI Spider Diagram



At present, there is a provision for the differently abled and elderly population in BRT buses, with stickers inside the vehicle to remind passengers to give priority seats to women, the elderly, and differently abled users. Ramp facilities for wheelchairs and dotted lines for the blind are also provided. Such measures help to increase the social inclusiveness of the BRT system and should be continued.

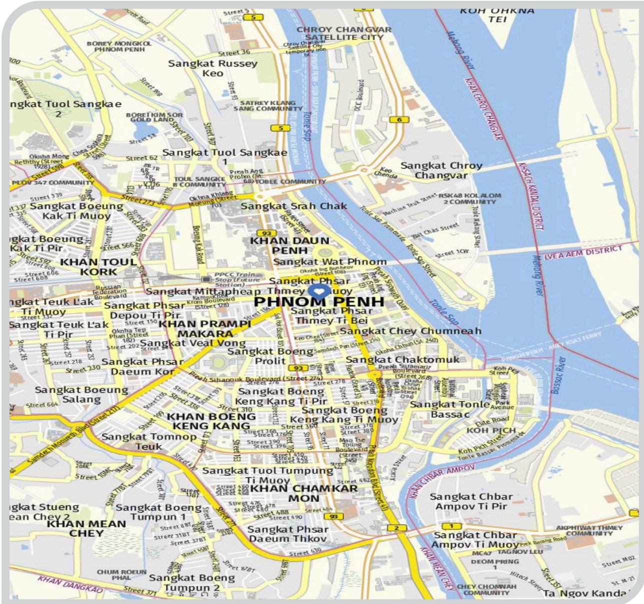
3.17 Phnom Penh (2021)

3.17.1 City Overview

Phnom Penh is home to more than two million people, approximately 14% of the Cambodian population, and is expected to grow to 2.86 million by 2035. The current population density is estimated to be about 3,200 inhabitants per square km. The boundaries of the city encompass an area of 679 square km and is divided into 14 administrative divisions (khans). The city is strategically located at the confluence of three main rivers, the Mekong, Tonle Sap, and Bassac rivers, as well as at the junction of several corridors along the Asian Highways. Key facilities and industries, such as Sihanoukville Port, Phnom Penh Port, Kampong Chhnang New Airport, and the Agro-industrial Zone on the east bank of Mekong River, have helped establish the city as the economic, social and cultural centre of the country.

Double-digit economic growth rates in recent years have triggered an economic boom, with new hotels, restaurants, schools, bars, high rises and residential buildings being built around the city. The main sectors driving the economy have been garments, trading, real estate and tourism. Tourism has grown rapidly in recent years; the sector's total contribution to Cambodia’s GDP was 32.4 per cent of GDP in 2017, the highest among all member states of the ASEAN, and directly provides about 13.6 per cent of jobs. Many travelers

Figure 3.52 Phnom Penh City Map



visit Phnom Penh on their way to and from the country's most famous destination, Angkor Wat in Siem Reap. A new satellite city, Camko City, is being developed at a cost of US$ 2.6 billion, with various new infrastructure projects including roads, canals and railway systems planned to connect Camko City and Phnom Penh.

There are several ambitious urban planning strategies, of which the most important for urban transport development are the Phnom Penh Sustainable City Plan 2018-2030; the Phnom Penh Master Plan on Land Use 2035; and the Phnom Penh Urban Transport Master Plan 2014-2035. These various plans seek to improve the connectivity of the city such as to suburban areas in the west, including through the development of several major ring roads and bridges. Many primary and secondary roads are also disrupted due to topographical conditions such as rivers. Pedestrians sometimes have to walk on roads because of the poor condition of sidewalks and the fact that many are used for parking and business activities, despite being public land. According to UNDP, sidewalks and open public spaces within Phnom Penh cover only 16.4 per cent of total space within the city. The estimated 2.1 per cent of open public space in Phnom Penh (e.g., parks, places to exercise and for civic participation), is well below the international standard of 10%.

As of 2020, the number of vehicles registered in Cambodia was 5,718,650. Of this number, there are 2,403,495 registered vehicles in Phnom Penh, which is around 42% of total registered vehicles across the country (MPWT, 2021).

Phnom Penh has relatively few public transport options. As of 2019, Phnom Penh public buses are run on 13 routes in the city, using a fleet of over 200 buses, and are thought to carry approximately 30,000 passengers daily on average. The various concessions given to certain vulnerable groups such as young children and senior citizens who are over 70 years old have helped to increase the popularity of bus services, but also mean that up to 60 per cent of passengers are riding for free. Since 2017, Phnom Penh Capital Administration (PPCA) have been implementing "The Project for Improvement of Public Bus Operation in Phnom Penh" (PiBO), but many activities had to be suspended in the face of the COVID-19 pandemic. Despite this, the PiBO project is helping to modernize the bus fleet.

3.17.2 SUTI Results

With regards to transport planning (Indicator 1), all stakeholders, particularly the Phnom Penh City Administration, City Bus Authority and the Ministry of Public Works and Transport, are required to concentrate and make efforts to follow the master plan to improve city public transport. Although these plans are very comprehensive, limited attention is given to cycling networks. Although planning documents prioritize intermodal transfer facilities, insufficient financial resources are allocated to them. Though difficult to estimate due to insufficient information, it is estimated that the annual average amount reserved for public transport facilities in Phnom Penh from 2017 through 2020 is about USD 112 million (Indicator 8).

A striking result of the SUTI assessment was the extent to which Phnom Penh's commuters use private transport modes, especially motorcycles (Indicator 2). A lack of data makes it difficult to conclusively estimate the modal share of private vehicles, but traffic counts undertaken by UNDP at two separate sites estimated that private cars and motorcycles made up about 86% of all vehicles. Data on active transport modes, such as walking and cycling are not available, but these modes are thought to make up a very small proportion of trips.

One reason may be because there are few public transport options at present. Bus transport is the only public transport system currently available in Cambodia. For indicator 3 on access to public transport, there are currently 625 official bus stops (as of 2020) and access is fairly good in inner areas but moderate in suburban areas. Another reason may be that the quality of services is regarded as unsatisfactory (Indicator 4). An online survey of 480 people conducted as part of this SUTI assessment found that respondents were fairly satisfied on aspects such as comfort and cleanliness of vehicles, safety of vehicles, and availability of information, but were less satisfied with punctuality, frequency of services, and personnel courtesy.

However, the fares of city bus transportation are affordable for most bus commuters. While this encourages inclusivity, the fare box recovery ratio is very low compared to the expenses (fares make up less than 50 per cent of the operational costs), so the government is subsidizing the services (Indicator 7).

In the years immediately before the COVID-19 pandemic, the traffic safety rates were worsening in terms of the number of accidents, fatality rates and serious injury rates. The government has taken an active role in addressing traffic safety. A National Road Safety Committee (NRSC) has been jointly created by the Ministry of Public Works and Transport, the Ministry of Interior, and the Ministry of Health, with technical and financial support from Handicap International (HI). Senior ministers from relevant ministries serve as chairs of this Committee.

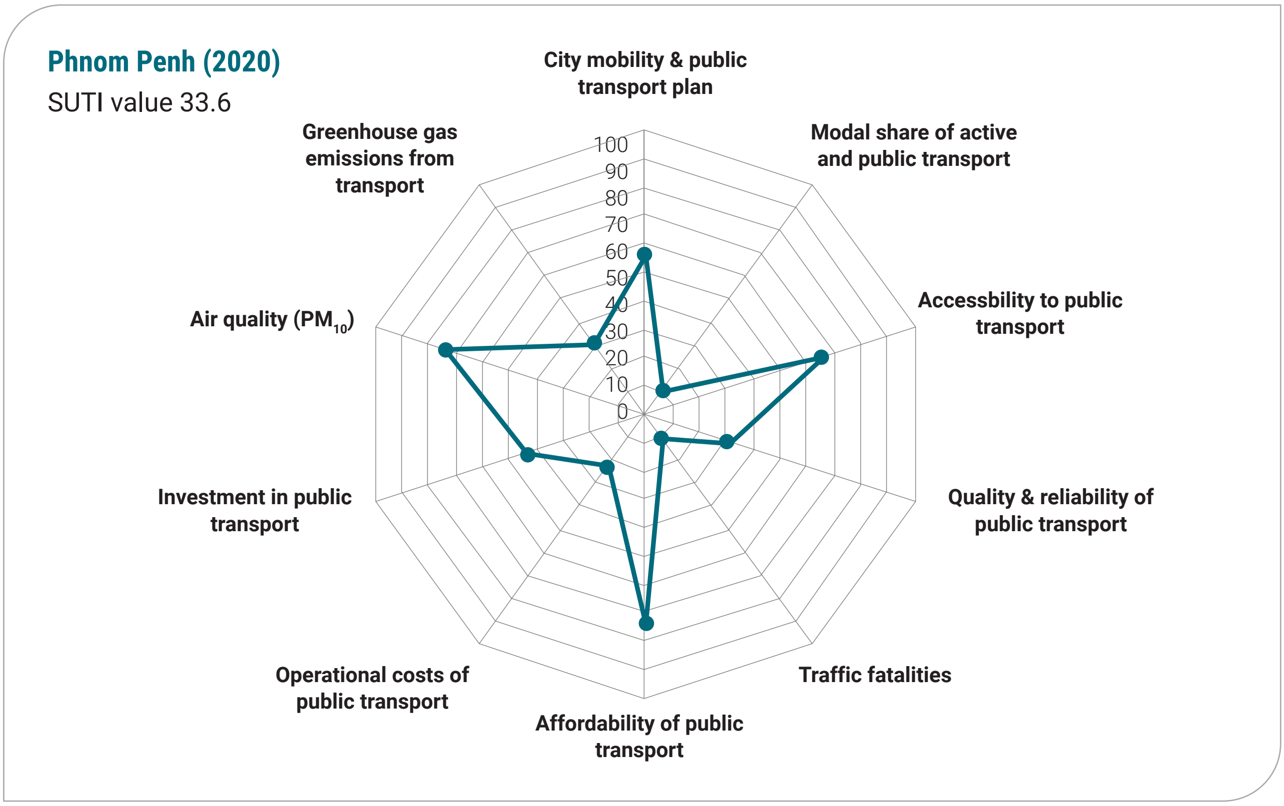
With a large number of old individual transport vehicles, the air pollution (Indicator 9) and GHG emissions (Indicator 10) are very serious in Phnom Penh capital city. The estimated CO_2 emissions per capita in 2019 in Phnom Penh was 1.94 tons of CO_2.

3.17.3 Future perspectives

The SUTI score is 33.6 for Phnom Penh[43].

The SUTI analysis confirmed the strengths and weaknesses of Phnom Penh's urban transport system. One current shortcoming is that the different aspects of SUTI are currently under the responsibilities of different organizations, which make it difficult to coordinate actions. Furthermore, these aspects need clearly

Figure 3.53 Phnom Penh SUTI Spider Diagram



defined and adequately funded implementation and monitoring mechanisms. There should be a focus of measures to increase the mode share of public transport. Active transport modes, such as walking and cycling, are generally neglected and need more support to develop appropriate infrastructure.

Public bus services have steadily improved, but the cost recovery ratio is very low. In order to make the bus operation financially sustainable, the government and stakeholders need to engage entities relevant to public transport services. There is a need to improve public transport accessibility and quality of public transport, which requires more investment. At the same time, incentives and regulatory measures to limit privately owned cars and facilitate public transport flows may help improve the reliability and punctuality of public transport.

There is a need to improve transport safety through use of technology, enforcement of traffic laws, helmet use and for two-wheelers, better driver education. Due to the growth of the vehicle population with diesel engines, as well as traffic congestion, air pollution and GHG emissions are rapidly increasing. The government needs to take actions to protect citizens from the health impacts of transport vehicles.

3.18 Surabaya (2018)

3.18.1 City Overview

Surabaya is Indonesia's second largest city and the capital of the East Java province. With an area of 350 km^2 and 3 million inhabitants, it is the economic centre of the eastern part of Indonesia. Located in the East Java Province, facing a narrow strait (Madura Strait) that provides an ideal harbour, it acts as a transit city between Jakarta and Bali. It attracts more than 1.5 million people from surrounding areas every day, and also acts as the centre for distributing goods to the eastern part of Indonesia.

Surabaya's spatial structure is unusual. It consists of large, concentrated clusters of high-density residential developments (>400p/ha) intermingled with high density job clusters (>200/ha). The residential clusters are large, covering an area of more than 60 km^2. Though this maximises access to jobs with shorter trips, this type of urban structure may pose a problem for the provision of public transport. The area made up by roads is low at 5.8 per cent. There are 2,120,168 registered vehicles in Surabaya (as of 2015). Two-wheelers are predominant, accounting for 78 per cent of the registered vehicles. The share of cars/jeeps is about 4 per cent. Mini vans and buses account for 12 per cent of the stock. People in Surabaya are dependent mainly on motorcycles (54 per cent) and personal cars (35 per cent), with the public transport system making up only a minor proportion of trips (city bus at 3 per cent; microbus at 5 per cent; and train at 2 per cent). The NMT share is only 2 per cent.

Public transport in Surabaya is provided by both state-owned companies and private operators. There are 16 standard bus lines operating on trunk lines, and 58 minibus (Angkot) lines connecting collector and lower order roads. While low frequency and the slow speed of public transport are unfavourable factors for passengers, its large outreach is a positive point. The low-floor Suroboyo Bus service, introduced in 2018 as part of the Public Transport Reform, operates trunk and feeder lines. These buses are equipped with passenger information systems so that passengers can trace the nearest bus position adjacent to the closest bus stop from them. Tickets for this service can be purchased using plastic bottle waste.

Figure 3.54 Surabaya City Map

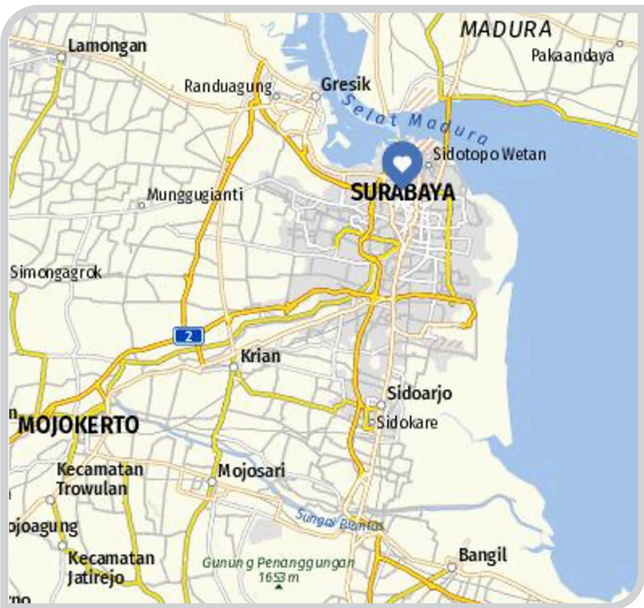


Figure 3.55 Surabaya – Traffic and City Transport Services

Traffic Condition in Surabaya

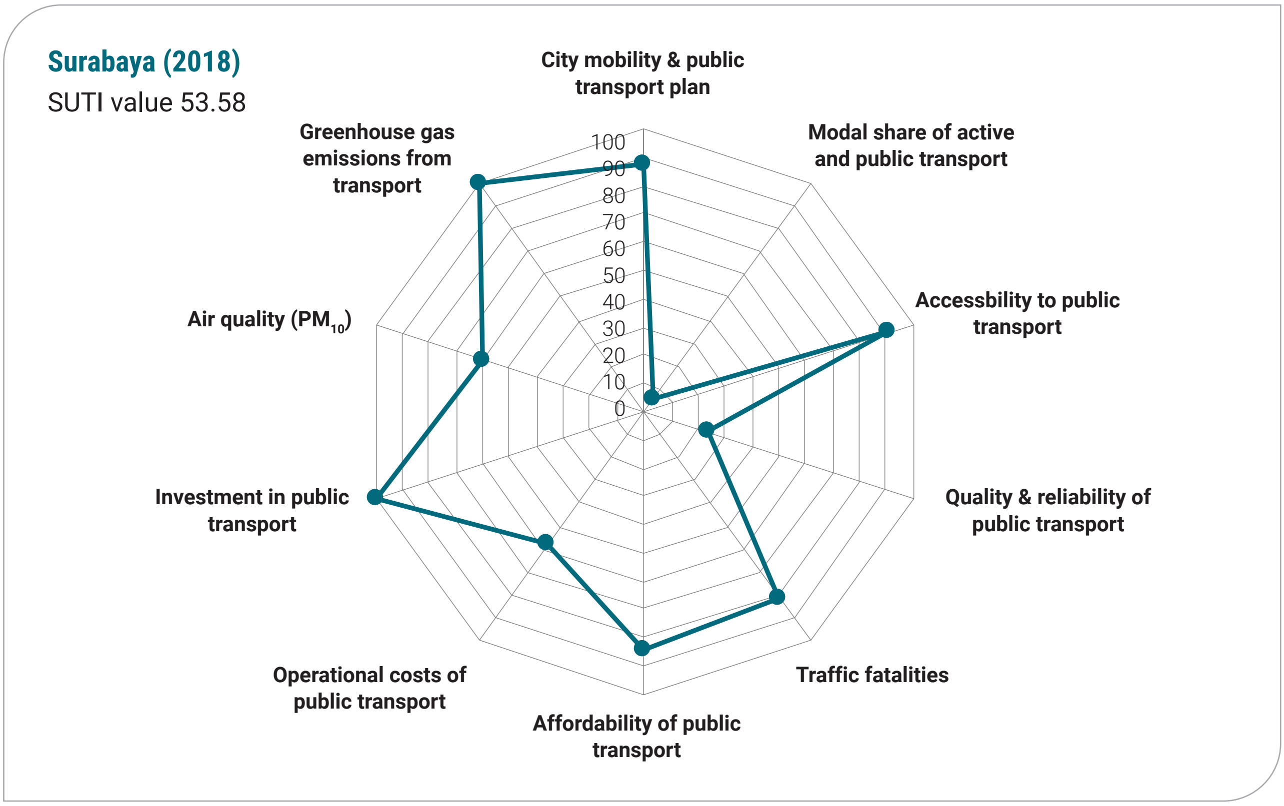
Angkot Minibus

3.18.2 SUTI Results

The aggregate SUTI score for Surabaya[44] is 53.58.

Surabaya's performance regarding traffic safety is moderate (6.4 fatalities per 100,000 inhabitants). The per capita GHG emissions in the city are very low (0.18 tons/annum). The air quality level (PM_{10} – 65.96 μg/m^3) is good.

Figure 3.56 Surabaya SUTI Spider Diagram



The modal share of public and active transport is very low (13.95 per cent). Convenient access to public transport is available for 93 per cent of the population. The minibus transport covers almost the whole of the city and its periphery. The public transport quality and reliability index is low, with only 45 per cent satisfied customers. Fares are relatively affordable, with low-income groups spending an average of 8.4 per cent of their income on transport. Public transport operators, who are mostly private, recover full costs of operations. The figures for investments indicate that about 71 per cent of total transport investments made by the city are in favour of public transport.

Since 2011, Surabaya's plans have focused on pedestrian facilities, bicycle lanes, public transport and multimodal integration. This is consistent with the appearance of current intermodal facilities, disabled-friendly sidewalks and bicycle lanes in the city centre.

3.18.3 Future perspectives

The city needs to focus on increasing the share of public transport by enhancing the quality and reliability of services. The situation is likely to improve by continuing to develop pedestrian facilities, bicycle lanes, public transport and modal integration. However, the competition from two-wheelers with on demand App-based service is posing challenges to the formal public transport systems. There has been a lot of discussion on developing a mass transit system such as trams and BRT, but they are yet to be implemented. A greater use of renewable energy in public transport can help reduce GHG emissions and improve air quality.

3.19 Surat (2018)

3.19.1 City Overview

The city of Surat, with a population of 5.21 million and spread over an area of 326.52 km2, is the eighth largest city in India. Surat is a major industrial and trade centre in the state of Gujarat. It is also known as the diamond capital of the world and the textile capital of India. Textile manufacturing, diamond polishing and petrochemical industries form major components of the economic base in the city. Over 50 per cent of the workforce is engaged in manufacturing. It is a high-density city, with much of the trade and manufacturing units located in the city centre.

The city has a hierarchical road network system. The total length of road network within the Surat Municipal Corporation (SMC) is 3,859 km.

The number of vehicles registered with the Surat Regional Transport Office has risen from 62,000 in 1980 to 3 million in 2018. In the last five years alone, the growth in vehicles has been around 9 per cent per annum. The two-wheeler is the predominant mode of transportation in Surat, accounting for 63 per cent of trips (excluding walk trips). The share of public transport modes is low, at 2 per cent. The share of walk and cycling trips is about 43 per cent, which is high due to the compact and mixed land use development in the city.

Currently, the city bus services (CBS), Bus Rapid Transit Services (BRTS) and the High Mobility Corridor (HMC) are being operated on a gross cost basis by Sitilink Ltd., under the SMC. Surat's integrated public transport system has been judged as the Best Mass Transit System (2018) by the Ministry of Urban Housing and Urban Affairs, Government of India.

Figure 3.57 Surat City Map

Figure 3.58 Surat City Transport Services

BRT system

High Mobility Corridor

3.19.2 SUTI Results

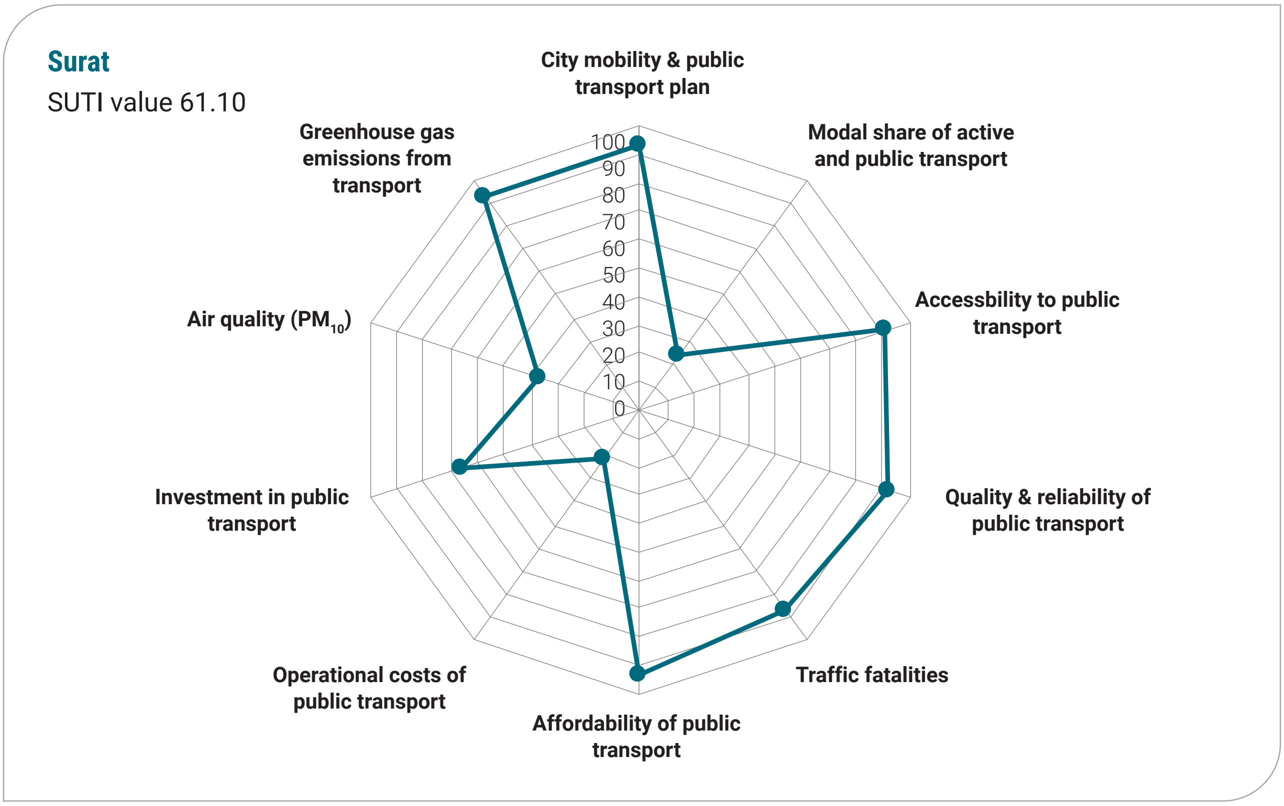
The aggregate SUTI score for Surat[45] is 61.10.

In Surat, traffic safety performance in terms of SUTI value is rated 'good'. The low share of public transport is a concern. The public transport system is heavily subsidized. Per capita GHG emissions in the city are low (0.18 tons/annum), but its inhabitants suffer from poor air quality (PM_{10} – 98.26 μg/m^3).

The modal share of public and active transport is low (29 per cent), despite 92.6 per cent of the population having convenient access to public transport. The public transport quality and reliability is high, with 89.7 per cent satisfied with the service. Fares are very affordable, with low-income groups spending an average of 5.57 per cent of their income on transport. The public transport operator, Sitilink, recovers 54.7 per cent of the cost of operations. During the last five years, the city has been investing significantly in the development of the public transport system (32.8 per cent of total transport investment).

The city is focused on the development of sustainable mobility. It has recently revised its City Mobility Plan (CMP) focused on 'SARAL (Safe, Accessible, Reliable, Advanced and Low-Carbon) Mobility', which is the city's transport motto.

Figure 3.59 Surat SUTI Spider Diagram



3.19.3 Future perspectives

The SUTI assessment found that there is a need to initiate promotional activities to increase the mode share of public transport. There is also a need to improve formal public transport by introducing a new cleaner fleet. The existing fleet of informal public transport modes (three-wheelers) needs greater governmental oversight to enhance safety and accessibility.

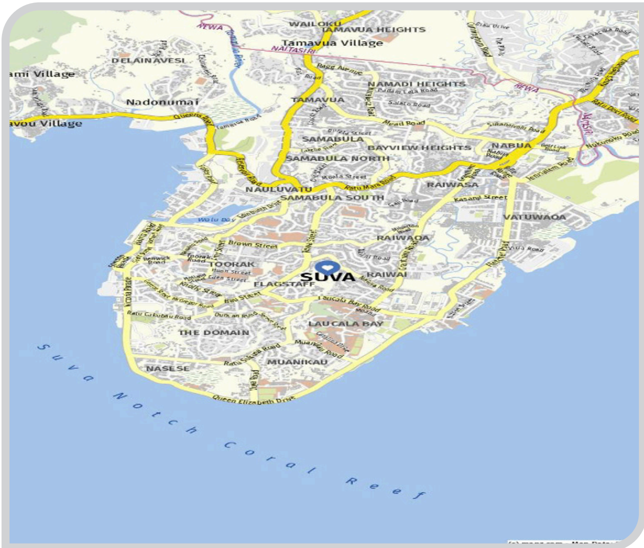
There is also a need to further explore alternative operations and financing models for meeting the revenue–expenditure gap, which is wide and unlikely to be fully covered even with increased ridership. The municipal government should work more closely with the state government for wider geographical monitoring of PM_{10}/$PM_{2.5}$.

3.20 Suva (2018)

3.20.1 City Overview

The Greater Suva Area (GSA), Fiji's largest urban agglomeration, includes four municipalities: Suva, Nasinu, Nausori, and Lami Towns. Suva, the capital of Fiji, is one of the largest cities in the Pacific, with a population of about 280,000 (2014 estimate). The GSA accounts for 31 per cent of Fiji's population and 59 per cent of its urban population. By 2030, the population of GSA is projected to grow to 345,000.

Figure 3.60 Greater Suva Map



While agriculture and fishing predominate Fiji's economy, the significance of tourism, sugar manufacturing, textiles, garments, footwear, and tobacco are growing. As the national capital, GSA is the political, economic, and cultural capital of the Pacific, hosting several regional headquarters for companies and international agencies. It is also a major hub for shipping services between North America, Australia, and New Zealand as it acts as a distribution centre for regional South Pacific countries. These activities have a significant impact on the land transport network.

GSA development is concentrated along three major roads: Kings Road linking Suva to Nausori and the north coast of Viti Levu, Queens Road, linking Suva to Lautoka via Lami, Pacific Harbour and Nadi, and Princess Road – via the Tamavua Ridge to the Waimanu River and Nausori. Beyond the major roadways, there is no distinction between major and minor local roads. Gaps in the network connectivity due to lack of bridges across the rivers are a major issue.

In terms of the transportation system, GSA relies heavily on road transport. The public transport system in Greater Suva is considered to be generally 'good' and consists mainly of private bus, minibus and carries (para transit modes or informal transport modes). The bus operation is mainly undertaken by the private sector, and transport infrastructure and facilities are inadequate. While about 9 per cent of the trips are walking trips, the infrastructure for walking is inadequate.

Figure 3.61 Greater Suva – Traffic and City Transport Services

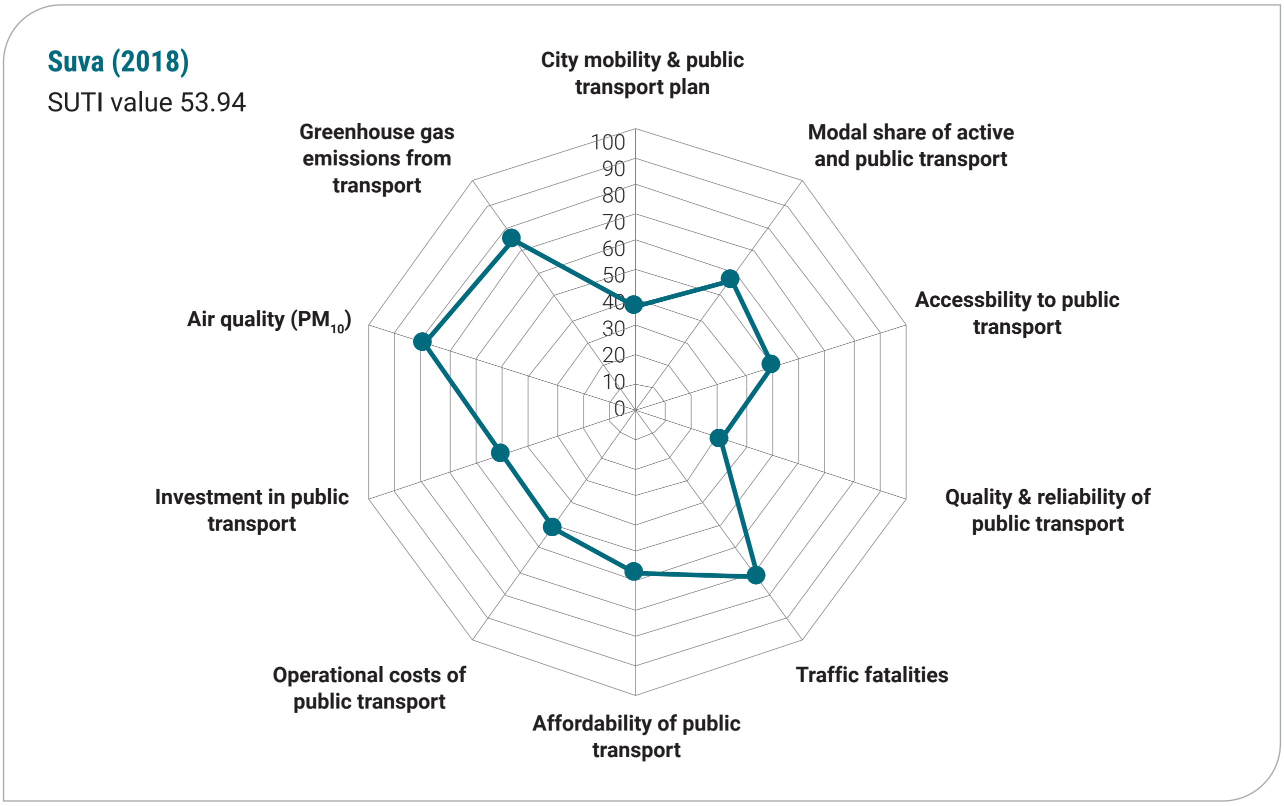
Grantham Road

Bus Terminal

3.20.2 SUTI Results

The aggregate SUTI score for Suva[46] is 53.94.

Figure 3.62 Suva SUTI Spider Diagram



The Transportation Strategy document suggests that Fiji has a culture of public transport usage. The dependence of people in GSA on active and public transport is high, with 46 per cent trips taken using regular buses, 1 per cent by using minibuses and 9 per cent of trips made by walking. About 60 per cent of the population has convenient access to public transport. The quality and reliability of public transport needs improvement, as people's satisfaction levels are at 50 per cent. Fare levels are moderate, with lower income groups spending about 17 per cent of their income for transport expenses. Public transport is operated by the private sector, and it is able to recover its full costs (100 per cent). The public transport investment share in the total transport investments is 25 per cent.

In Suva, per capita GHG emissions in the city are low (0.67 tons/annum) and the inhabitants of the city enjoy relatively clean air quality (PM_{10} – 40 µg/m^3). However, traffic safety (9.6 fatalities per 100,000 inhabitants) is a major concern.

The Fiji Roads Authority has developed a Greater Suva Transportation Strategy 2030, with a vision to develop 'an integrated sustainable transport system that contributes to an inclusive, prosperous and environmentally responsible region'. Finding resources to fund these identified requirements is still a challenge.

3.20.3 Future perspectives

Some of the major identified areas of action are the development of a comprehensive public transport plan to supplement road transport, a dedicated bicycle network, bus corridors, accessible streets (pedestrian infrastructure), intermodal facilities, bus terminals and bus stops. More focus is required to improve safety in general and the safety of pedestrians and vulnerable road users.

The supply of privately operated public transport needs to be augmented. Furthermore, rationalisation of routes and schedules is necessary to ensure quality and reliability of service. Due to growing urban populations, the accessibility needs to be improved including for people with different needs. The proposed transport corridor linking Suva and Nausori would also improve accessibility. There is ongoing discussion on the need to shift to renewable sources of energy for transport, including a shift to electric mobility. Private bus operators were seeking policy support to improve their fleets as well as to bring in electric vehicles. Unlike many Asian cities, public transport was reported to be making a profit in Suva.

The concentration of PM_{10} particles is fine. However, the lack of air quality monitoring stations in Suva as well as in Fiji, calls for the early establishment of such station(s).

3.21 Tehran (2019)

3.21.1 City Overview

Greater Tehran is located in the northern centre of the country and has an average altitude from sea level of 1,280 meters. In 2017, the population of Tehran was 9.1 million and the population density in Tehran was 12,100 per square km. The city area covers about 750 km² and includes 22 municipals.

In 2017, the daily consumption of gasoline and diesel fuel for transportation was 12 million and 4.6 million litres, respectively. The vast road network of Tehran includes 931 km of highways, freeways and interchange ramps and loops. The total length of major streets (primary & secondary arterials) is 1,053 km, while the length of local streets is about 1,552 km.

Tehran's bus system has 240 regular buses and 10 BRT lines. The bus lines are operated by both the public and private sectors, with 1,348 and 4,800 buses respectively. The total length of bus routes and BRT lines is about 3,200 km. The annual ridership of bus lines in 2017 was 541 million passengers. The Tehran metro includes six lines, with a total length of 215 km and 114 stations. In 2017, the total trips travelled by metro totaled 723 million. One of the most used public transport modes in Tehran is the taxi, which numbered 78,722 vehicles in 2017. The yearly and daily passengers travelled by registered taxis in Tehran in 2017 were 1,261 million and 3.5 million passengers, respectively.

Figure 3.63 Tehran City Map

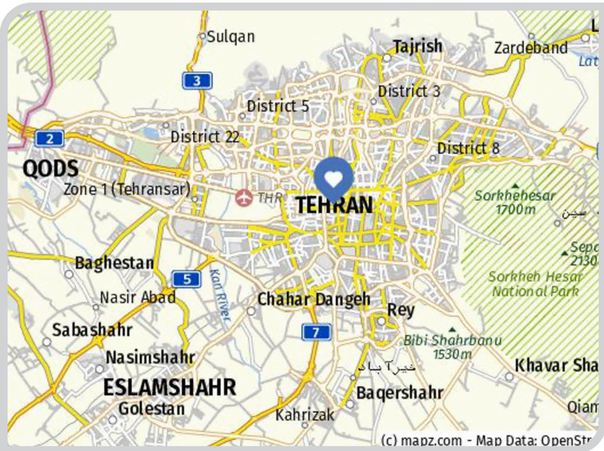


Figure 3.64 Tehran Transport Services

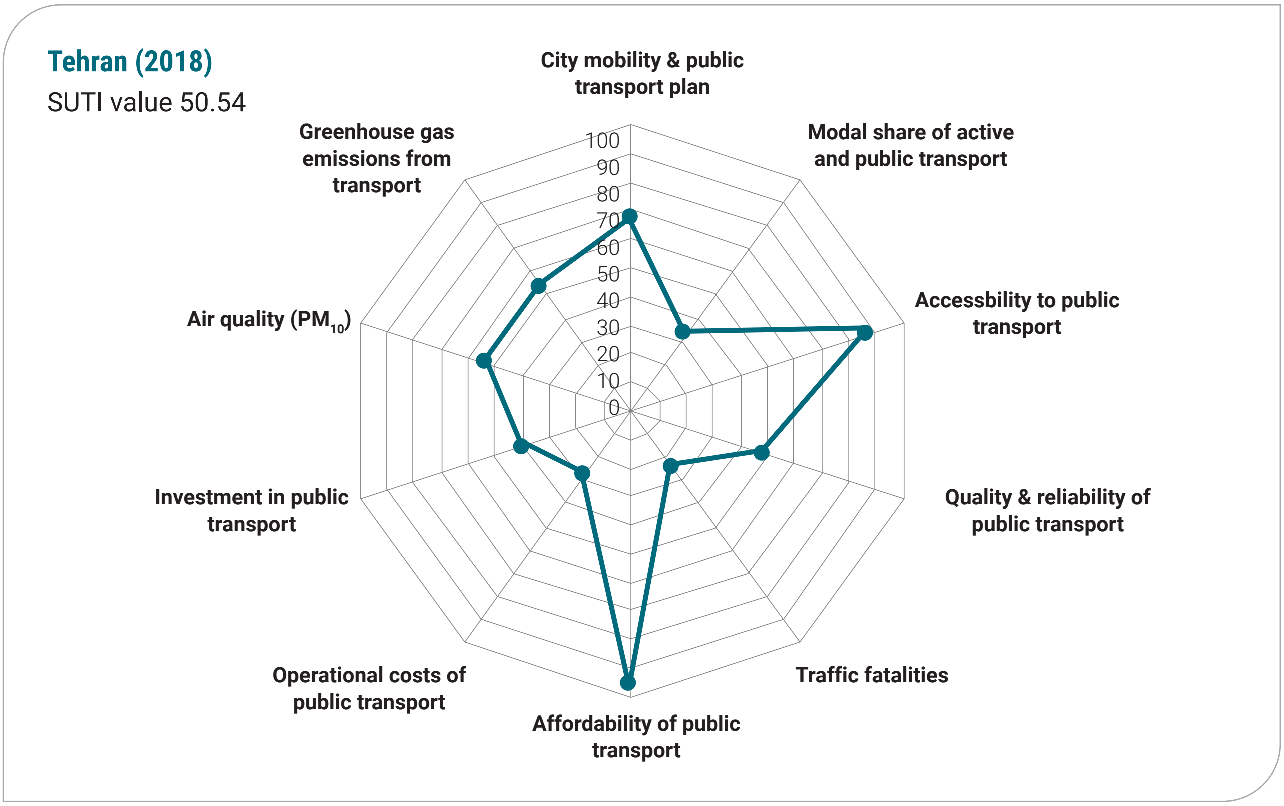
3.21.2 SUTI Results

The aggregate SUTI score for Tehran[47] is 50.54.

Tehran has an affordable and conveniently accessible public transport service (93 per cent), and the quality and reliability of this service from the users' point of view is relatively good (62 per cent of satisfied users). The results show that the coverage of public transport, intermodal facilities, and the infrastructures of active transport in Tehran's transport plan is good.

However, a number of weak areas could also be identified, including the high rate of traffic fatalities (7.39 fatalities per 100,000 population), the operational cost of public transport systems (45 per cent fare box ratio), and the modal share of active and public transport (37 per cent) in total daily trips taking place in Tehran. The investment in the public transport systems is low (21 per cent) and air quality is poor.

Figure 3.65 Tehran SUTI Spider Diagram



3.21.3 Future perspectives

Tehran has an affordable and high-quality public transportation system. However, the modal share of public transport in total daily trips is low. Efforts are required to increase the mode share of public transport and increase investment in the public transport system, including in active modes of transport. In order to attract more commuters, the city needs to employ both pull and push polices by discouraging the use of private vehicles and increasing the reliability of public transport. For this to happen, better coordination among various transport operators and authorities is essential.

3.22 Thimphu (2019)

3.22.1 City Overview

Thimphu city has grown both in terms of population size and area. The population of Thimphu has increased from 79,185 in 2005 to 114,551 in 2017, compounding annually at a 3.1 per cent rate as compared to 1.1 percent for the total population of Bhutan. Massive rural-to-urban migration has contributed to high growth of the city's population.

Thimphu is situated on a narrow Wangchu river valley running north to south, with limited scope for spread towards the east and west of the city. Topographical features of Thimphu have also contributed to the growth pattern of its transport circulation system. The major road network runs approximately 17 km across the valley, while secondary roads and pathways form the tributary transport circulation system to connect the western and eastern hubs to the major transport lines. At present, the running length of the road networks in Thimphu is about 270 km. About a fifth of primary and secondary roads have pedestrian networks (covering 47 km running length). In the absence of trains and ferries, road transport is the only mode of public transport in Thimphu. Walking continues to be a major transport mode. Unlike in other cities in Asia, informal transport modes such as three-wheelers, cycle rickshaws and tempos do not operate in Thimphu.

Approximately 56,000 people commute daily in Thimphu. A fleet of 56 city buses, 3,024 taxis, 36,567 private cars, 1,591 government cars and 3,334 two-wheelers support commuters (RGoB, 2019). About 52 per cent of people use private and government cars for commuting, 22 per cent walk, and 15 per cent use city buses.

Figure 3.66 Thimphu City Map

Figure 3.67 Modal Share in Thimphu (in per cent)

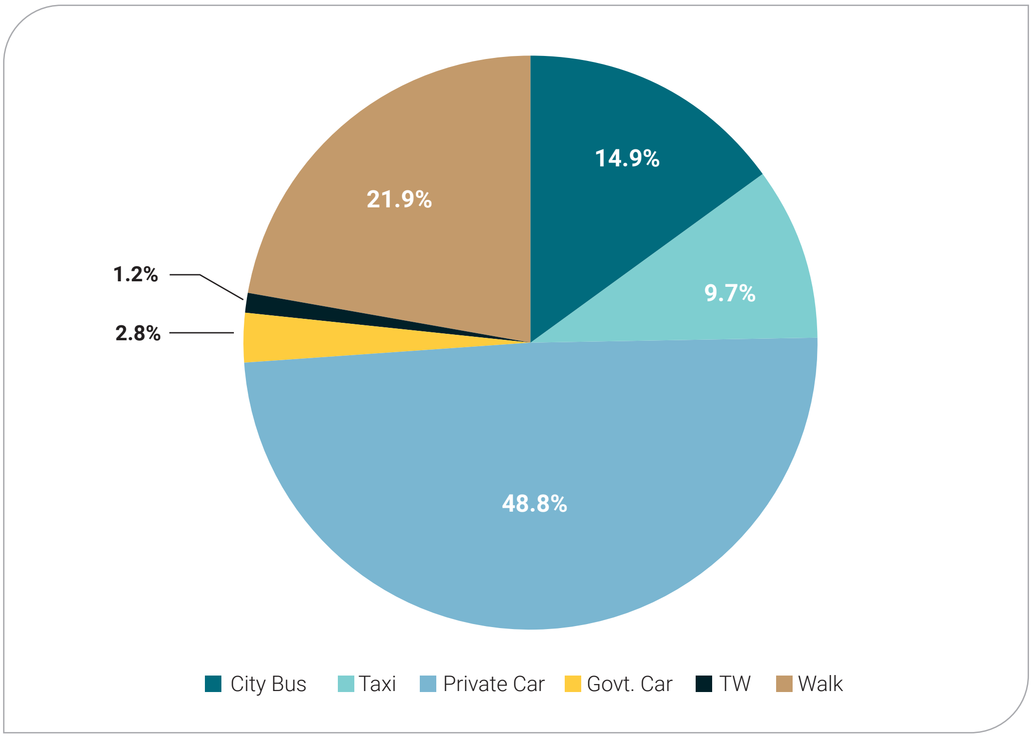


Figure 3.68 City bus in Thimphu

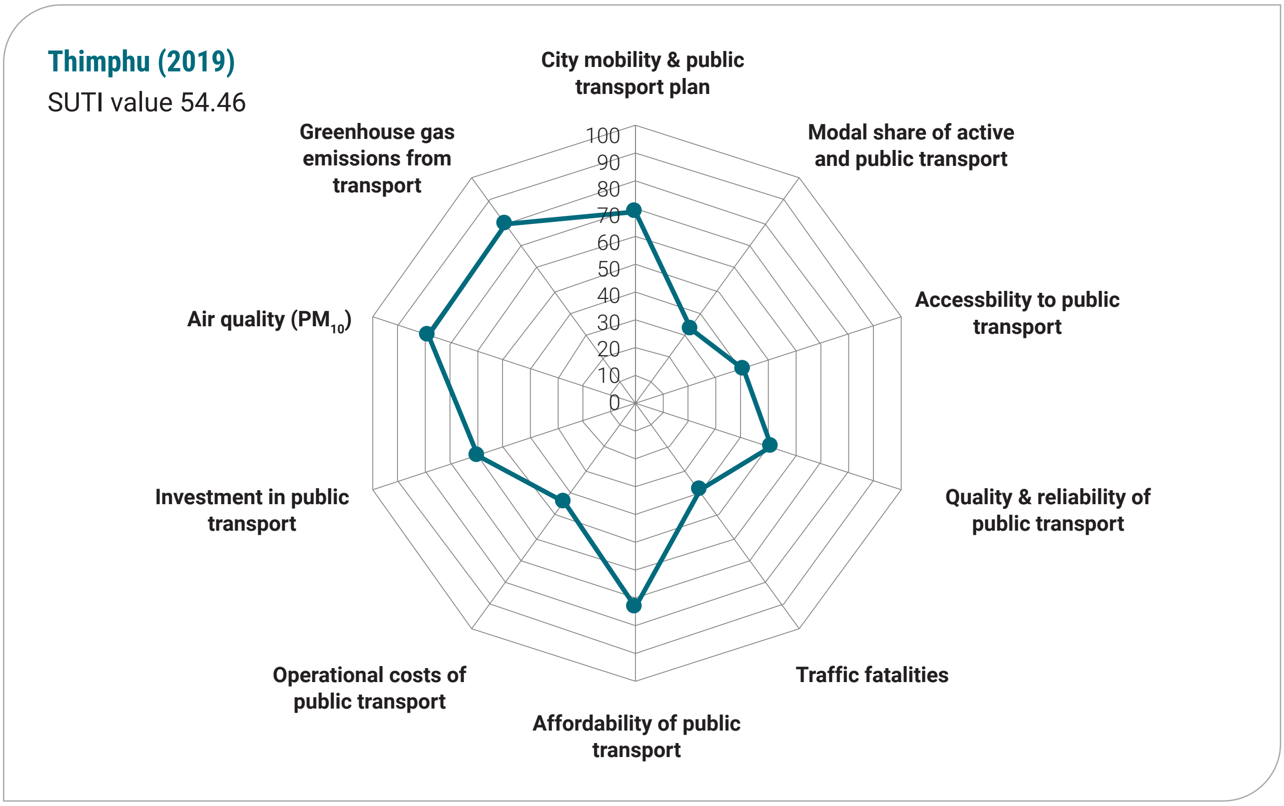
3.22.2 SUTI Results

The aggregate SUTI score for Thimphu[48] is 54.46.

The major challenges to the sustainability of public transport are found to be the low mode share of public and active transport (36.8 per cent), accessibility (52.8 per cent), road safety (7 per 100,000 people) and fare box ratio (30 per cent). Thimphu performed well on indicators of air quality and GHG emissions, with normalized scores of over 75. The rising number of vehicles, increasing number of driving license holders, narrow roads and mounting traffic congestion have become a major cause of traffic accidents in Thimphu. The poorest income quintiles allocate only about five percent of their expenditure on transport as compared to 19 percent by the richest income quintile.

At present, there are four city bus operators in Thimphu, but the Bhutan Postal Corporation Limited controls about 98.8 percent of the market share. Yet, it recovers only 56 per cent of its operational costs and make losses on this business. The Royal Government of Bhutan subsidizes public transport to ensure the financial viability of Bhutan Postal Corporation.

Figure 3.69 Thimphu SUTI Spider Diagram



In 2018, 11.9 million litres of petrol and 13.7 million litres of diesel were sold in Thimphu, which equates to roughly 63,635 tons of CO_2. In per capita terms, it is 0.56 tons of CO_2 per person per year. Overall, there is a need to bring about a much-desired shift from private transport towards public and active modes of transport. Since the road expansion and its widening may not be possible due to terrain related challenges, only modal shift can address the imminent threat of traffic paralysis.

Development of dedicated bus stops, bus bays, effective dissemination of information about the timing of bus services and its reliability will help to make city bus services more popular and accessible. Policy intervention in public transport has had limited success so far.

3.22.3 Future perspectives

The modal share of city transport is lopsided and unsustainable, as personal vehicles (personal cars, taxis, institutional cars and two-wheelers) contribute to two thirds of total transport trips. The rapidly rising urban population, high consumer preference for personal cars, limited scope for road widening and inconvenient access to public transport make the task of achieving sustainable mobility a challenging one. Given the size of city and topography, there has been discussion on suitable type of mass public transport – some expert suggests a mini-BRT for Thimphu. There was a study on LRT linking Thimphu and Paro.

Private participation in public transport is very small at present, and consequently the investment burden falls heavily on the public sector. The public transportation system is almost monopolized by a public sector operator who is supported by subsidies by the government. Low private investment in public transport overburdens the government and tends to reduce the pace of change. Some major projects such as the BRT are delayed due to funding constraints. One option may be to promote PPP model to overcome these challenges.

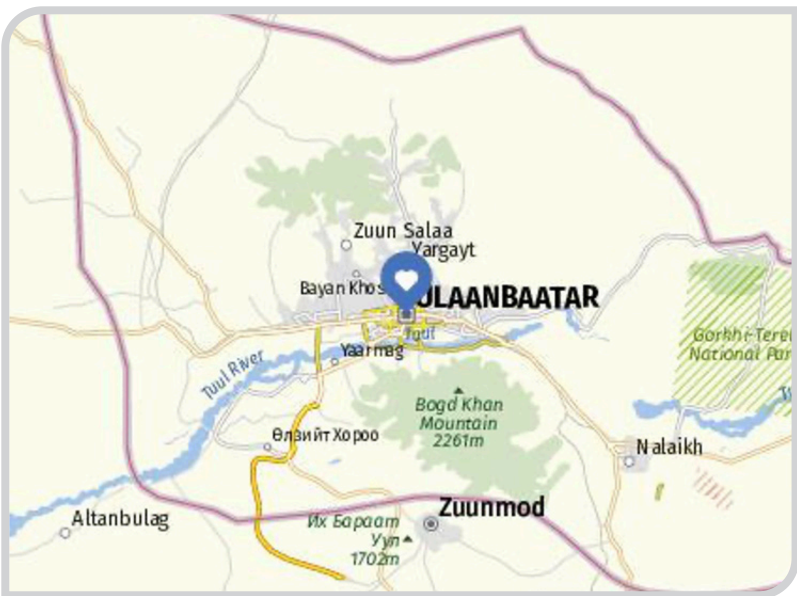
From the perspective of environmental sustainability, Bhutan has a great opportunity to utilize its green energy in transport and make the transition to electric mobility. There are efforts to electrify public taxis.

3.23 Ulaanbaatar (2019)

3.23.1 City Overview

As the capital and largest city of Mongolia, Ulaanbaatar is the country's industrial, economic, financial, science and technological, cultural and political heart. The Ulaanbaatar city area, considered for the SUTI study, spans over 3789 km^2 and houses a population of 1.49 million people. The Ulaanbaatar city area is comprised of six districts Bayangol, Bayanzurh, Chingeltey, Han-Uul, Songinohayrhan and Suhbaatar. The total number of households was 387,453 with an average size of 3.72 persons in 2018. As the main industrial, trade and business center of Mongolia, Ulaanbaatar produces 66.3 per cent of Mongolia's total gross domestic product.

Figure 3.70 Ulaanbaatar City Map



A total of 244.8 km international and state roads pass through the territory of Ulaanbaatar. As of 2018, the road network of Ulaanbaatar City consisted of 875.2 km of paved roads compared to 799.2 km in 2017 (which at the time comprised of 148.6 km of primary road and streets, 226.0 km of secondary road and streets, and 404.6 km of local district streets). The average road density in Ulaanbaatar City was 2.1 km per km^2 of land area.

Driven by increased economic activities and high urban population growth, motorization has grown rapidly in the past 15 years. The total number of registered vehicles in Mongolia increased 1.6 times, from 608,000 to 971,000 vehicles, between 2012 and 2018. In 2012, the number of registered vehicles in Ulaanbaatar was 367,814, of which 72.9 per cent were cars. By 2018, this had increased to 365,819 registered vehicles (1.46 times), of which 70.2 per cent were cars (1.54 times increase).

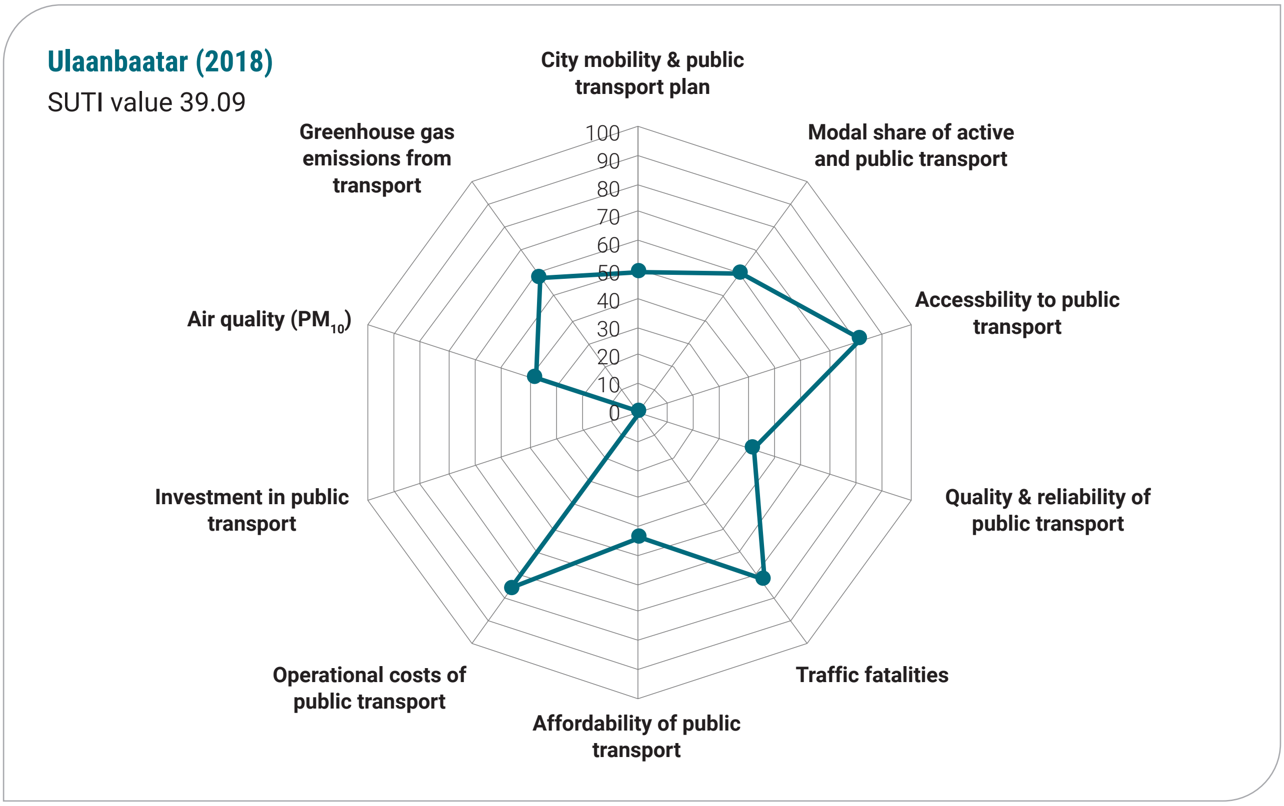
Every day, an estimated 650,000 to 750,000 passenger trips are made through different public transport services in Ulaanbaatar. On average, the daily ridership is over 600,000 on weekdays and over 350,000 during weekends. The modal share in the city as per the household survey conducted by Traffic Control Centre in 2017 comprised of car (49.2 per cent), bus and trolleybus (39.3 per cent), walking (6.5 per cent), taxi (2.6 per cent), bicycle (1.2 per cent), motorcycle and moped (0.7 per cent), and employee transportation bus (0.6 per cent). There are 34 bus companies operating 1,171 vehicles, of which 88.6 per cent are large sized bus, 1.7 per cent articulated buses, 4.5 per cent medium sized buses, 0.9 per cent minibuses, 4.3 per cent trolleybus and 48.3 per cent taxi to meet the people's public transport demand. The public transport network consisted of 126 routes including 76 main routes, 15 feeder routes, 17 express routes, 3 camp routes, 14 suburban routes and 1 night route in 2018. The total length of routes was 3,735 km in 2018, which increased by 39 km from the previous year. In 2018, 180.9 million passengers carried by public transport accounted for 607.6-million-person km.

Figure 3.71 Bus and bus Stop in Ulaanbaatar

3.23.2 SUTI Results

The aggregate SUTI score for Ulaanbaatar[49] is 39.09.

Figure 3.72 Ulaanbaatar SUTI Spider Diagram



While the road development plan is well articulated, Ulaanbaatar needs a comprehensive public transport master plan and to decide on a type of mass transit system suitable for the city. Despite many studies on ways to improve urban transport in the city, poor quality and reliability of the public transport and lack of investment in public transport is a major cause of concern.

Accessibility of public transport is good with 85 per cent coverage. However, the city needs more efforts to increase the share of active and public transport which is at 55 per cent. Use of digital payment and traffic management systems may help to encourage more people to switch to public transport.

The traffic fatality rate is high compared to other Asian capital cities. The public transport fares are at an affordable level. However, operational costs are not fully covered and public transport operators receive subsidies. Measures to increase ridership and discourage personal vehicles would help to increase fare revenues.

In order to improve accessibility for more than 800,000 residents living in ger districts, improvement of various forms of informal transport should be considered. The city needs to shift to renewable energy sources to reduce GHG emissions. Efforts are underway to introduce electric public transport and discourage the use of aged vehicles.

3.23.3 Future perspectives

The SUTI highlighted the urgency for Ulaanbaatar's transport planners to decide on a mass transit system for the city and invest in the public transport system, infrastructure for active mobility and better quality and reliability of services. Given the severity of the traffic safety situation, there is a need to increase efforts to raise traffic safety awareness and strengthen the enforcement of traffic rules and regulations. A shift to renewable energy in transport and to electric mobility will improve air quality and reduce GHG emissions.

3.24 Yangon (2020)

3.24.1 City overview

Yangon is the former capital of Myanmar with a population of 5.2 million (2014 census) and a population density of 5,346 persons per km^2. The population of the city is expected to reach 7.7 million by 2035. Administratively, Yangon is divided into 4 districts (north, east, west, and south) and 33 townships.

The length of the city's road network is 126 km (with more than 6 lanes), 429 km (4 lanes), and 9,255 km (2 lanes). The share of the overall road area to the total urban area is only 4.5 per cent. During 2011 to 2018, the total number of vehicles in the Yangon region increased from 210,923 to 533,776, expanding by 2.5 times.

The current urban transport systems in Yangon city include road transport, railways, waterways, ports and airports. The Yangon Regional Transport Authority (YRTA), formed in 2016, oversees road and water public transport modes and is expected to further develop as an integrated urban mobility authority in Yangon. Residents of Yangon rely heavily on buses, which account for about 49 per cent of the total motorized trips and carry about 2 million passengers a day. At present, urban railway services are operated by Myanmar Railways, which has a total network length of 82 km and 46 stations in Yangon.

Figure 3.73 Yangon City Map

Figure 3.74 Yangon - Bus Services

Yangon Bus Service Airport Shuttle Bus

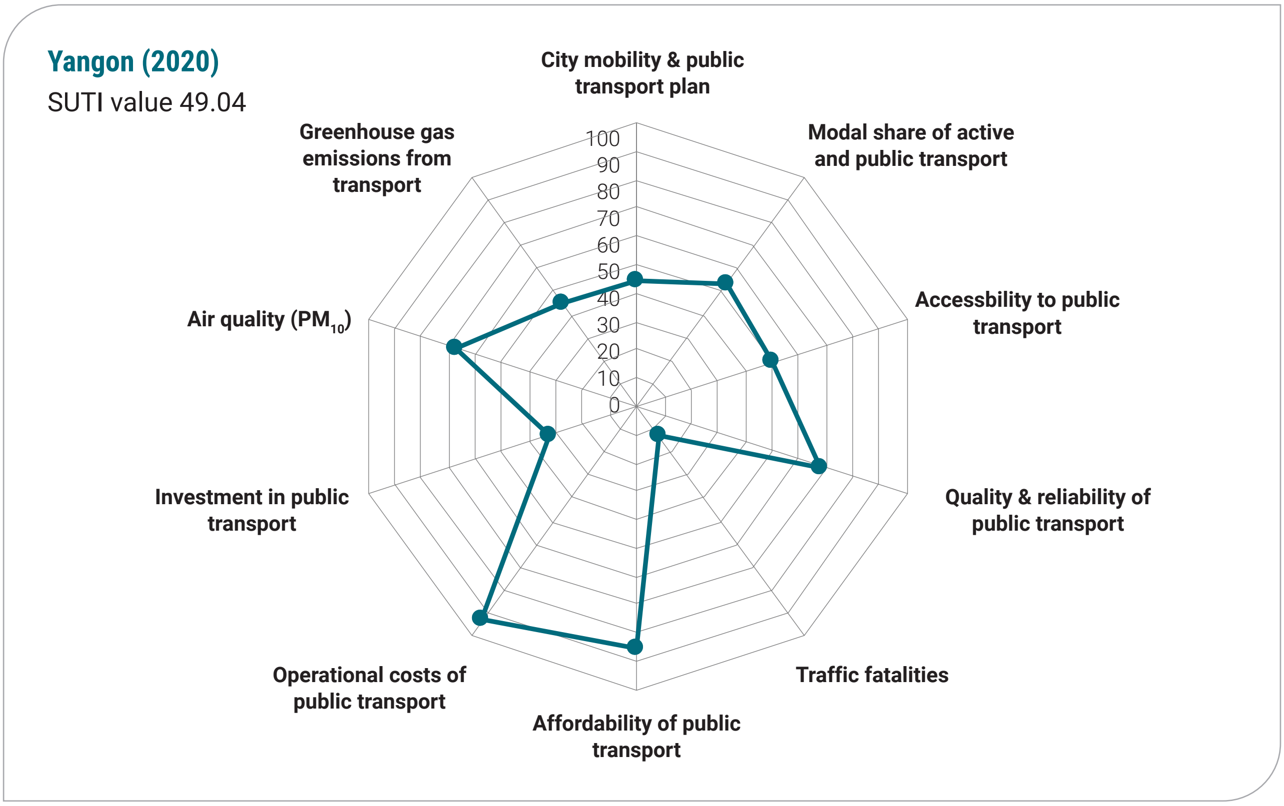
The total number of registered taxis increased by over three times from 2011 to 2017, reaching over 70,000. There are three major water transport routes in Yangon which cater to around 1 million passengers. In October 2017, the first phase of Yangon Water Bus started to operate between the Insein and Bothtaung areas. The operation of the first phase was planned to target about 20,000 daily commuters at a frequency of 20 minutes.

3.24.2 SUTI Results

The aggregate SUTI score[50] for Yangon is moderate with 49.04.

In Yangon, the rate of traffic fatalities is very high at 9 fatalities per 100,000 inhabitants. The per capita GHG emissions in the city are also high (1.51 tons/annum).

Figure 3.75 Yangon SUTI Spider Diagram



The people of Yangon are predominantly dependent on buses, railways, cycling and walking for their mobility needs (mode share – 52.9 per cent). However, public transport access is limited to only 59.6 per cent of the population. The quality and reliability of public transport is moderate (74.5 per cent satisfied passengers). Public transport fares are good, with the bottom 20 per cent of the population spending an average of 8.1 per cent of their monthly income on transport. The operators are able to recover 94.4 per cent of the operations costs. During the last five years, the city has been investing moderately in the development of the public transport system (16.5 per cent of total transport investment). The city has moderate air quality (PM_{10}– 55.31 µg/m^3).

The city has developed ambitious goals under the 2019 "Comprehensive study of the urban transport development program in greater Yangon" (YUTRA) study report prepared by the Yangon Regional Government and the Yangon City Development Committee.

3.24.3 Future perspectives

The city needs to focus on achieving the targets set in the YUTRA urban transport plan through improvements in active and public transport, investing in mass transit, urban transport infrastructure and service, and increasing the coverage of public transport. Improvement and rehabilitation of the urban circular railway, with modernization of rail stations, as well as park and ride schemes in the Yangon city area would help to increase ridership. In addition, using a business-like approach to review existing fares, maximize non-farebox revenues and minimize operation costs would greatly improve the commercial practices of public transport operators.

Given the poor safety record, measures to reduce the fatality rate should be urgently taken up by the city. Most accidents can be traced to poor driving. Better training and investments in driver and passenger safety should be made a priority.

Yangon should utilize its rich natural resources and use CNG gas in public transport and taxis. Myanmar should also consider shifting to renewable energy sources and electric mobility for public transport. It is important to enhance coordination among the Yangon Urban Mobility Board (YUMBo), Yangon Regional Government, Yangon City Development Committee (YCDC), and Myanmar Railways to implement the YUTRA.

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[27] Weningtyas, 2018
[28] Siridhara, 2020
[29] Swami, 2019
[30] De Silva, 2017
[31] Alam, 2018
[32] Chung, 2017
[33] Hai, 2018
[34] Ahmed, 2021
[35] Prayudyanto and Thohir, 2017
[36] Mehta, 2019a
[37] Khokhali, 2017
[38] Kabir, 2019
[39] Sadeghi, 2021
[40] Gaspay, 2021
[41] Agustien, 2020
[42] Ikhsan, 2020
[43] Monykoran, 2021
[44] Herijanto, 2018
[45] Surat Municipal Corporation, 2018
[46] Ministry of Infrastructure and Transport, 2018
[47] Mojtehedzadeh, 2019
[48] Mehta, 2019b
[49] Eldev-Ochir, 2019
[50] Thein, 2020


CENTER

COMPARATIVE ASSESSMENT OF URBAN MOBILITY 4

This chapter presents an overview of the SUTI performance for the 24 cities presented in Chapter 3. Given the significant differences between cities in terms of size, structure, and socioeconomic and demographic conditions, as well as the data collection methods adopted by each city to measure the SUTI indicators, caution is needed when comparing the SUTI performance across cities. However, it is possible to make some broad observations about how each city is doing with respect to different indicators.

The 10 SUTI indicators can broadly be categorized as representing four dimensions: (i) Transport system dimension - indicators related to public transport plans (Indicator 1) and mode share of active and public transport (Indicator 2); (ii) Social dimension - convenient access to public transport services (Indicator 3), public transport quality and reliability (Indicator 4), traffic fatalities (Indicator 5) and affordability (Indicator 6); (iii) Economic dimension - operational costs (Indicator 7) and investment in public transportation systems (Indicator 8); and (iv) Environmental dimension – air quality (Indicator 9) and greenhouse gas emissions from transport (Indicator 10).

4.1 Aggregate SUTI Scores

Tables 4.1 and 4.2 show the sustainable transport performance indicated by the aggregate SUTI score and the normalized values for the 24 cities. The SUTI scores for the 24 cities have values ranging from a low of 30.36 for Islamabad and Rawalpindi (2021), 32.24 for Palembang (2020) and 32. 4 for Hanoi (2017) to a high of 67.33 for Metro Manila (2021), 61.3 for Pekanbaru (2020) and 61.2 for Surat (2018).

The performances of six cities are above the mid-value of 50-60: Greater Jakarta with 55.25 (2017), Thimphu with 54.56 (2018), Suva with 53.94 (2018), Surabaya with 53.58 (2018), Bhopal with 53.33 (2019), and Tehran with 50.54 (2019).

The performances of eight cities are in the range of 40-50: Mashhad with 49.34 (2020), Yangon with 49.04 (2019), Bandung with 48.96 (2018), Khulna 47.87 (2019), Kathmandu 47.8 (2017), Dhaka 46.27 (2018), Bangkok with 42.2 (2019), and Jaipur with 41.45 (2018).

The SUTI score of the remaining four cities range from 30-40: Phnom Penh with 33.6 (2020), Hanoi with 32.4 (2017), Ho Chi Minh City with 37 (2018), and Ulaanbaatar 39.09 (2018).

4.1.1 Transport system-related dimensions

The city profiles show that most cities have developed urban transport plans, but in many cities, the plans lack a comprehensive and integrated approach that considers all public transport options, intermodal transfer stations and infrastructure for non-motorized transport. Some cities did not have

Table 4.1 Indicator Normalized Values and SUTI Scores for 24 Cities (1)

	Indicator	Bandung	Bangkok	Bhopal	Colombo	Dhaka	Hanoi	Ho Chi Minh City	Islamabad and Rawalpindi	Jaipur	Greater Jakarta	Kathmandu	Khulna
1	City mobility & public transport plan	75	62.5	75	68.75	50	43.75	43.75	56.25	50	75	43.75	31.25
2	Modal share of active and public transport	11.68	34.49	75	81.81	96.39	0.81	23.15	51.49	38.73	35.1	74.71	22.5
3	Accessibility to public transport	22.5	69.58	65	30	45.6	50	69.71	45.31	51.2	46.9	81.25	39.48
4	Quality & reliability of public transport	88.72	58.26	80.68	0.15	12.2	76.87	18.11	14.88	23.86	49.2	33.33	60.84
5	Traffic fatalities	87.54	1	6.34	57.14	95.31	77.87	76.21	41	29.37	80.5	81.91	83.34
6	Affordability of public transport	90.48	99.93	98.41	70.41	60.7	92.98	92.98	77.53	99.92	67.9	75.87	79.53
7	Operational costs of public transport	16.73	100	100	46.9	34.14	19.57	15.89	1.43	52.55	55.6	52.55	30.15
8	Investment in public transport	59.2	100	37.4	49.6	100	4	27	69.38	11.67	100	35.68	62.38
9	Air quality (PM10)	71.43	77.93	32.14	74.29	9	28.24	32.44	16.76	49.45	53.6	44.29	30.71
10	Greenhouse gas emissions from transport	80.73	26.42	84.14	77.09	94.2	88.16	86.28	64.36	72	71.3	88.73	97.71
	Aggregate SUTI	**48.96**	**42.22**	**53.33**	**32.7**	**46.27**	**32.4**	**37**	**30.36**	**41.45**	**52.5**	**47.8**	**47.87**

Note: These are normalized values. For mobility assessment of cities in 2017 and 2018, the original SUTI framework was used. This was later updated to revise the scale of Indicators 5 and 7.

Table 4.2 Indicator Normalized Values and SUTI Scores for 24 Cities (2)

	Indicator	Mashhad	Metro Manila	Palembang	Pekanbaru	Phnom Penh	Surabaya	Surat	Suva	Tehran	Thimphu	Ulaanbaatar	Yangon
1	City mobility & public transport plan	50	58.33	62.5	68.75	56.25	87.5	93.75	37.5	68.75	68.75	50	43.75
2	Modal share of active and public transport	56.73	67.06	28.33	31.31	10	4.94	23.71	57.5	34.28	33.5	57.16	53.64
3	Accessibility to public transport	81.02	73.13	9.14	37.54	65.38	90.74	90.7	50	91.54	40.96	81.42	49.52
4	Quality & reliability of public transport	64.31	32.50	28.97	70.19	30.92	23.63	91.85	30.77	49.24	51.57	39.46	68.5
5	Traffic fatalities	31.01	71.10	37.46	64.14	10	81.78	86.9	72.57	26.06	38.89	72.31	12.67
6	Affordability of public transport	100	71.91	69.01	85.71	73.02	84.51	93.42	57.14	102.2	73.02	44.25	85.39
7	Operational costs of public transport	9.34	100.00	17.77	75.79	22	57.58	21.42	50.98	29.67	44.09	74.85	92.88
8	Investment in public transport	91.41	100.00	21.94	50.64	44	100	65.67	50	42	60.26	1.76	33
9	Air quality (PM10)	71.43	74.34	32.95	79.93	73.57	60.03	36.96	78.57	55.64	78.36	37.29	67.63
10	Greenhouse gas emissions from transport	31.11	54.93	81.36	78.59	30.91	99.93	93.29	75.64	55.42	79.8	57.6	45.06
	Aggregate SUTI	**49.34**	**67.33**	**32.24**	**61.32**	**33.6**	**53.58**	**61.1**	**53.94**	**50.54**	**54.46**	**39.09**	**49.04**

Note: These are normalized values, for mobility assessment of cities in 2017 and 2018 the original SUTI framework was used which was later updated to revise the scale of indicators 5 and 7.

approved urban transport plans and lacked seriousness in their implementation. Surat scores the best (indicator score 15/16) followed by Bhopal (12/16) and Surabaya (14/16). The high score reflects the fact that many cities have made plans with the goal of developing an integrated public transport system. The other cities have also developed plans for improving urban transport (mostly sectoral for public transport) with the lowest indicator scores for Khulna (5/16), Suva (6/16), Hanoi, Ho Chi Minh and Kathmandu (7/16), and Mashhad and Ulaanbaatar (both with 8/16).

Even though cities have public transport services, the mode shares of public transport in some cities are extremely low, for example in Phnom Penh, Bandung, Khulna, Surat, Surabaya, Hanoi, Islamabad and Rawalpindi. When combined with the mode share of active transport, Dhaka, Colombo, Kathmandu and Metro Manila scored high on mode shares. There is also discussion among cities about whether fixed route paratransit services should be counted as part of the public transport share. Either way, there is clearly scope for Asian cities to increase ridership and mode share of public transport. Also, the importance of non-motorized transport (i. e. active transport modes such as walking and cycling) became evident during the COVID-19 pandemic. Infrastructure to support these transport modes should be given priority in urban transport plans.

4.2 Social dimension

Accessibility is based on measuring the share of the urban population living within 500 metres of frequent public transport services. Tehran (91 per cent), Surat (90 per cent), Surabaya (90 per cent), Ulaanbaatar (81 per cent coverage), as well as Mashhad, Kathmandu and Metro Manila scored the highest scores in terms of providing convenient access to public transport services. The cities with low accessibility are Palembang (27 per cent), Bandung and Colombo, while Ho Chi Minh City, Hanoi, Bangkok, Bhopal, Jaipur, Suva, Yangon, Greater Jakarta, Dhaka and Thimphu provide moderate levels of public transport access.

The majority of cities were found to have poor public transport quality and reliability based on users' satisfaction surveys. The public transport quality and reliability in Surat is rated as good (with 89.70 per cent of respondents satisfied), followed by Bandung (87.67 per cent satisfied only for BRT) and Bhopal (82.44 per cent satisfied). The respondents in Colombo were the most disappointed with only 6.00 per cent satisfied respondents, followed by Dhaka and Islamabad and Rawalpindi. The majority of the respondents were not satisfied with the quality and reliability of public transport in Palembang, Ho Chi Minh City, Metro Manila, Surabaya, Phnom Penh and Kathmandu.

The road traffic fatality per 100,000 population was worst in Bangkok, followed by Phnom Penh, Yangon and Bhopal. Other cities having poor fatality records are Tehran, Mashhad, and Jaipur. The data in other cities shows moderate safety records. But for some cities, the analysed data is too good to be true, for example for Greater Jakarta and Dhaka. Past studies by the WHO also cites under-reporting of accident and fatality figures. Efforts to improve safety of public transport systems are important to enhance overall sustainability.

The public transport fares in all 24 cities are largely within affordable limits. Fare levels in Tehran, Bangkok, Mashhad, Jaipur, Bhopal, Ho Chi Minh City, Hanoi, Surat, Bandung, Surabaya, Pekanbaru, Kathmandu, and Yangon are highly affordable. In Khulna, Thimphu, Colombo, Greater Jakarta, Dhaka, Palembang, Metro Manila, Suva and Ulaanbaatar, fares are fixed at a moderate level. The affordable fare level has a direct impact on operational costs. The review of public transport fares is a very sensitive issue for city and federal governments.

4.3 Economic dimension

This dimension compares the revenue from tickets with the operating costs of the public transport companies, the so-called 'fare box ratio' indicator. The public transport systems in Bhopal, Bangkok, Metro Manila, Kathmandu, Yangon, Pekanbaru, Suva and Ulaanbaatar are able to recover most of operating costs of the public transport system. However, public transport operations in other cities are heavily subsidized by city and federal governments. In most cases, the subsidies hover around 50 per cent of operating costs. Therefore, cities should consider ways to enhance financial sustainability of public transport operations. Fare revision and introduction of non-fare revenue are some of the approaches used.

The investment in public transport is expressed as the share of investments in public transport systems out of total transport investments in the city. The average investment figure of the last five years from the date of assessment is considered. Metro Manila, Greater Jakarta, Dhaka, Surabaya, and Bhopal have invested heavily in mass public transport systems, but the share is very low in Hanoi, Ulaanbaatar, Ho Chi Minh City, Jaipur, and Kathmandu. In the aftermath of COVID-19, many cities are committing more investment in active and public transport development.

4.4 Environmental dimension

Air quality and greenhouse gas emissions from transport are assessed. The air quality indicator uses population-weighted air quality monitoring data reported to the national agency or WHO.

The performance of cities varies between 'very poor' in Dhaka', 'poor' in Bhopal, Islamabad, Ho Chi Minh City, Khulna, Phnom Penh, Palembang, Surat and Ulaanbaatar, and 'above average' in Bandung, Bangkok, Colombo, Kathmandu, Pekanbaru, Surabaya, Suva, Metro Manila, Thimphu and Yangon. The absolute values of air quality (PM_{10}) vary from 38.00 µg/m3 in Bangkok to 193 µg/m^3 in Jaipur. In many cities, the PM_{10} value exceeds the standards set by WHO for air quality.

Greenhouse gas emissions from transport as CO_2 equivalents were estimated using city-wide fuel sales data or actual vehicle kms of travel by mode and fuel type. The performance of all 24 cities for this indicator is good, with absolute GHG emissions values ranging from 0.0018 CO_2 metric tons per capita per year (Eq. Tons/capita/year) in Surabaya to 2.02 CO_2 Eq. Tons/capita/year in Bangkok. The SUTI normalised estimates of GHG emissions, measured in metric tons per capita, vary from 26.42 in Bangkok to 99.93 in Surabaya. The values are of a similar order of magnitude when compared to other major cities in the region, and higher when compared to cities in Europe and North America. The difference is explainable in terms of city structure, level of economic development, travel demand patterns and motorisation levels.

4.5 Tracking progress in cities over different assessment years

One of the objectives of the SUTI tool is to compare the performance of a city over time. The challenge remains in the collection and analysis of data and their availability. Greater Jakarta, Hanoi, Kathmandu, Colombo and Ulaanbaatar carried out SUTI assessments for two assessment years (2017 and 2019, except for Ulaanbaatar which did 2018 and 2021). The comparative analyses for these cities are given in Table 4.3.

Table 4.3 Indicator Normalized Values and SUTI Scores of Cities in Two Different Years

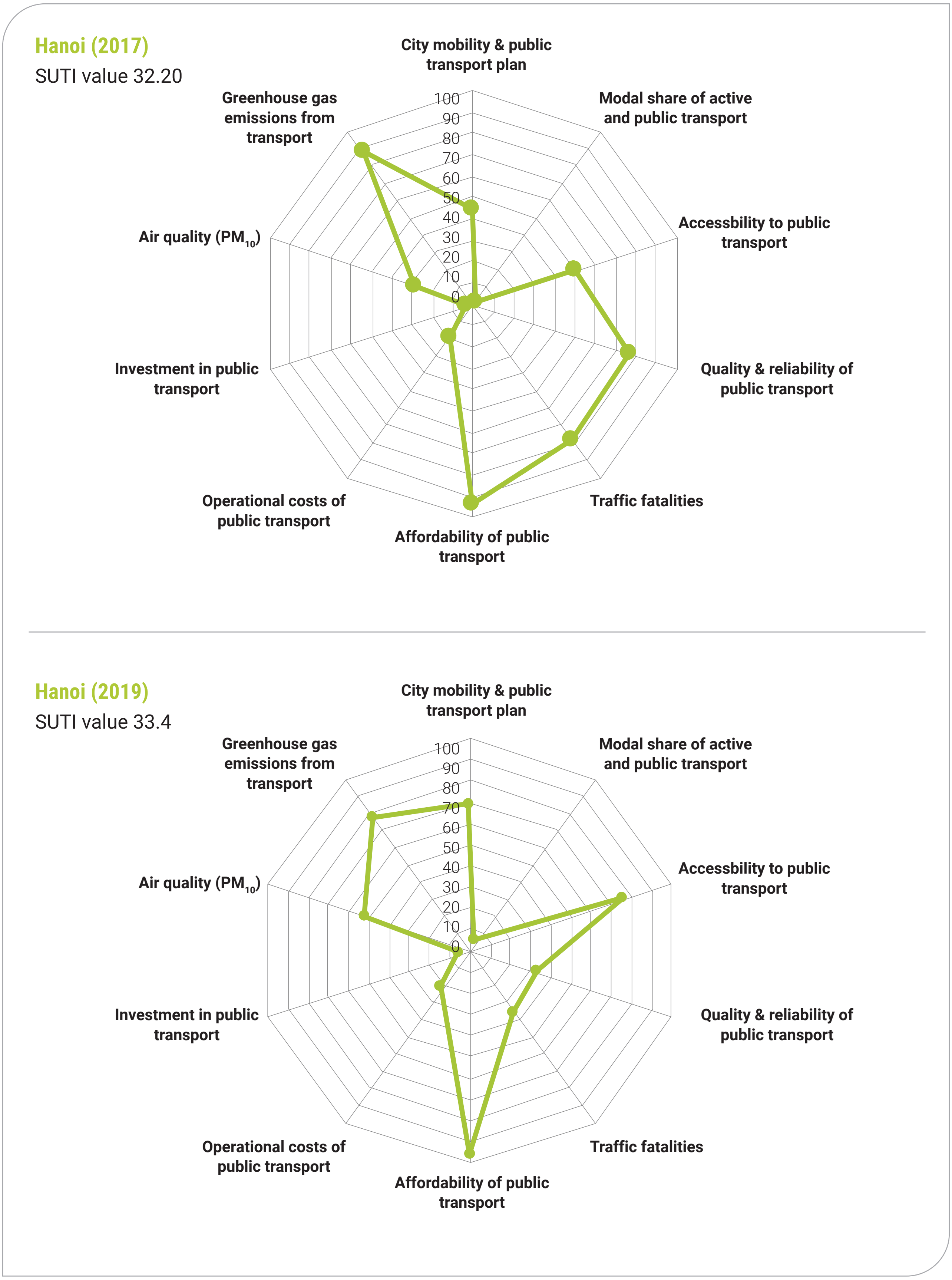
Sr. No.	Indicator	Hanoi		Greater Jakarta		Colombo		Kathmandu		Ulaanbaatar	
		2017	2019	2017	2020	2017	2020	2017	2019	2018	2021
1	City mobility & public transport plan	43.75	68.75	75	87.5	68.75	43.75	43.75	56.25	50	50
2	Modal share of active and public transport	0.81	5.33	35.1	27.5	81.81	74.22	74.71	41.25	57.16	57.16
3	Accessibility to public transport	50.00	76.25	46.9	37.46	30.00	27.36	81.25	72.50	81.42	82.28
4	Quality & reliability of public transport	76.87	33.80	49.2	56	0.15	1.54	33.33	29.23	39.46	25.63
5	Traffic fatalities	77.87	36.36	80.5	32.5	57.14	83.10	81.91	30.00	72.31	24.6
6	Affordability of public transport	92.98	95.99	67.9	59.49	70.41	100.00	75.87	100	44.25	39.5
7	Operational costs of public transport	19.57	21.79	55.6	41.88	46.90	67.77	52.55	53.85	74.85	17.11
8	Investment in public transport	4.00	4.56	100	100	49.60	27.59	35.68	84.00	1.76	1.76
9	Air quality (PM10)	28.24	50.73	53.6	66.54	74.29	91.56	44.29	85.71	37.29	57.36
10	Greenhouse gas emissions from transport	88.16	77.49	71.3	89.82	77.09	86.93	88.73	84.36	57.6	57.6
	Aggregate SUTI	**32.20**	**33.4**	**52.5**	**55.24**	**32.4**	**41.96**	**47.80**	**58.66**	**39.9**	**33.6**

4.5.1 Hanoi

The performance of Hanoi's transportation sector improved between 2017 and 2019[51]. The city has made substantial improvement in six indicators, and moderate improvement in the planning of public transport system and mode share of active and public transport. The overall SUTI value has increased to 33.4 from 32.2 (Figure 4.1).

It can be inferred from the table that the city has made deliberate efforts to improve transport facilities through different development plans, increased access to public transport services, affordability and also directed more investment to the public transport system. The value for public transport plans (Indicator 1) increased to 11/16 in the year 2019, compared to 7/16 in 2017. Similarly, the modal share of active and public transport (Indicator 2) increased to 14.27 per cent in 2019 from 10.65 per cent in 2017. It is also interesting to note that the investment in public transport systems remained the same in both assessment years (2 per cent of transport investment). However, it is worth noting that the construction of two elevated metro systems with external support is ongoing. The affordability of travel costs has also

Figure 4.1 SUTI Indicators for Hanoi 2017 and 2019



increased from 5.71 per cent to 4.76 per cent of income. Traffic fatalities have also gone down during the three-year period from 8 fatalities per 100,000 inhabitants in 2016, to 6 fatalities per 100,000 inhabitants in 2019.

However, a few areas have not shown improvements. The quality and reliability of public transport decreased from about 80 per cent satisfaction among respondents in 2017, to 51.97 per cent satisfaction among respondents in 2019. The cost recovery ratio was 51.90 in 2016, compared to 39 in 2019. The public transport systems have not been able to maintain the recovery of operational costs. Another serious challenge is the environmental effects of transport. Air quality decreased substantially (from 56.64 $\mu g/m^3$ in 2017 to 78.97 µg/m3 in 2019) while GHG emissions increased from 0.33 CO_2 tonnes per capita in 2017 to 0.62 CO_2 tonnes per capita in 2019. The following figures show variations in SUTI normalized scores in the year 2017 and 2019 for Hanoi.

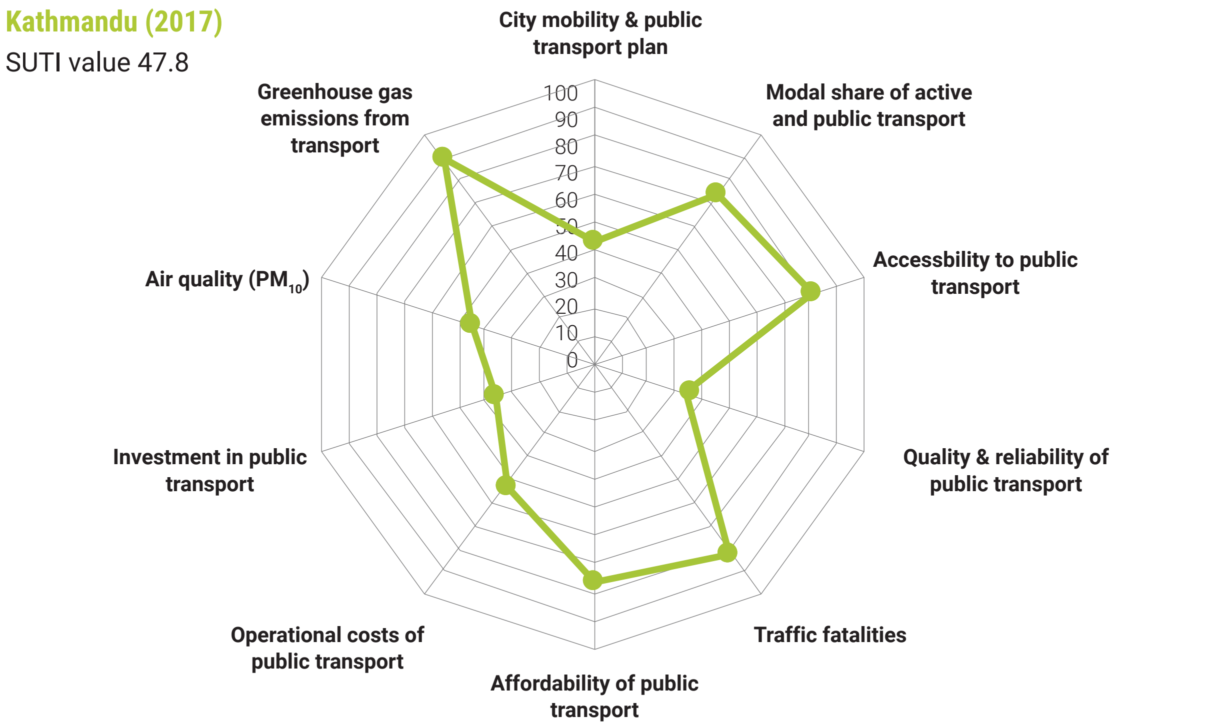
4.5.2 Kathmandu

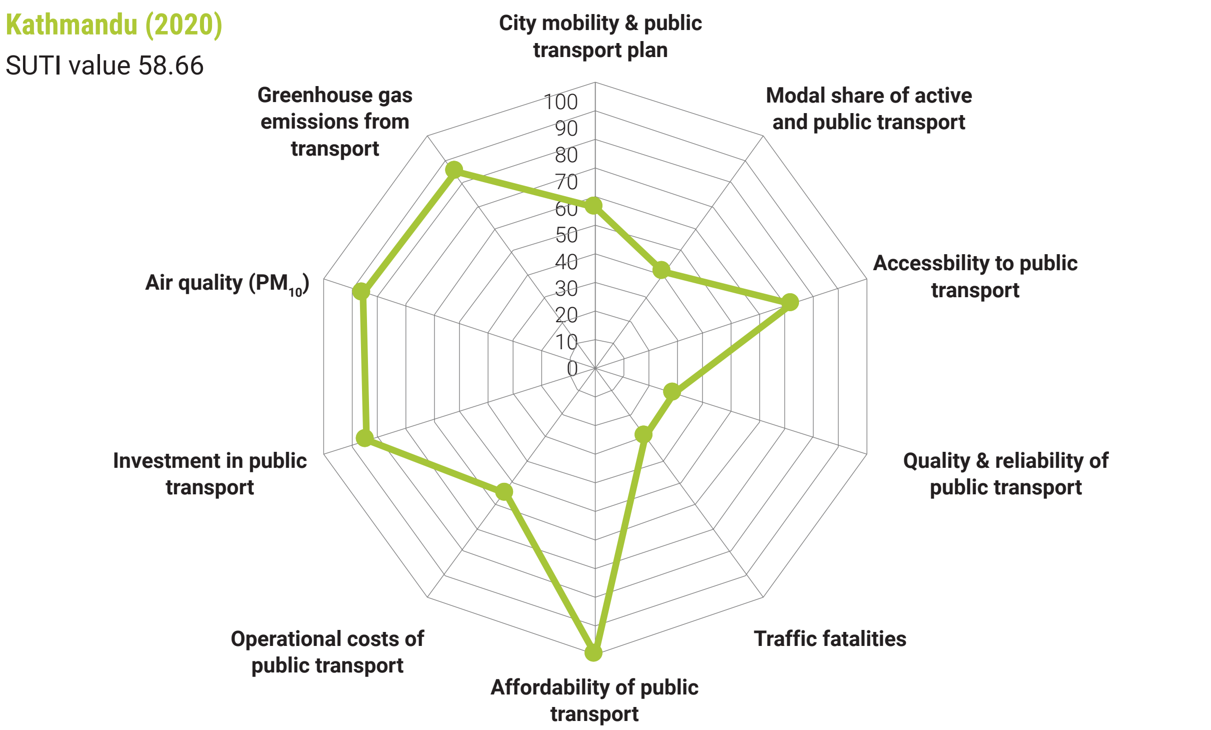
In Kathmandu, half of the SUTI indicators performed well, whereas the other half have not been satisfactory. The overall SUTI score reached 58.66 in 2019[52], as compared to 47.85 in 2017[53] (Figure 4.2). The improvements were mainly on investments in infrastructure, air quality, public transport quality and reliability, and affordability of public transport. However, one of the major shortcomings was that despite conducting various studies, Kathmandu lacked an approved integrated urban public transport plan.

Indicator 1 on public transport plans increased from 7/16 in the year 2017 to 9/16 in 2019. The affordability of travel costs also increased in 2019. Investments in public transport systems also increased greatly, from 17.84 per cent in 2017 to 42 per cent of total transport investments in 2019. A major achievement over the three-year period can be seen in the 'public transport quality and reliability' score. The value has increased from 33.33 per cent in 2017 to 49 per cent satisfied respondents. As most public transport is operated by the private sector in Kathmandu, they are almost break-even in terms of operational costs, with a good farebox ratio.

[51] Chung, 2019
[52] Poudyal, 2020
[53] Khokhali, 2017

Figure 4.2 SUTI Indicators for Kathmandu 2017 and 2019





Another noteworthy change has been in the 'air quality' indicator, which improved from 88 μg/m^3 in 2017 to 30 μg/m^3 in 2019. With regards to GHG emissions from transport, emissions increased from 0.31 CO_2 tonnes per capita in 2016 to 0.43 CO_2 tonnes per capita in 2019. Other areas where Kathmandu could have performed better were modal share of active and public transport in commuting, convenient access to public transport, traffic fatalities, recovery of operational costs of public transport system, and levels of greenhouse gas emissions from the transport sector. The SUTI values of both years and the spider diagram which compares the two years are shown below.

4.5.3 Greater Jakarta

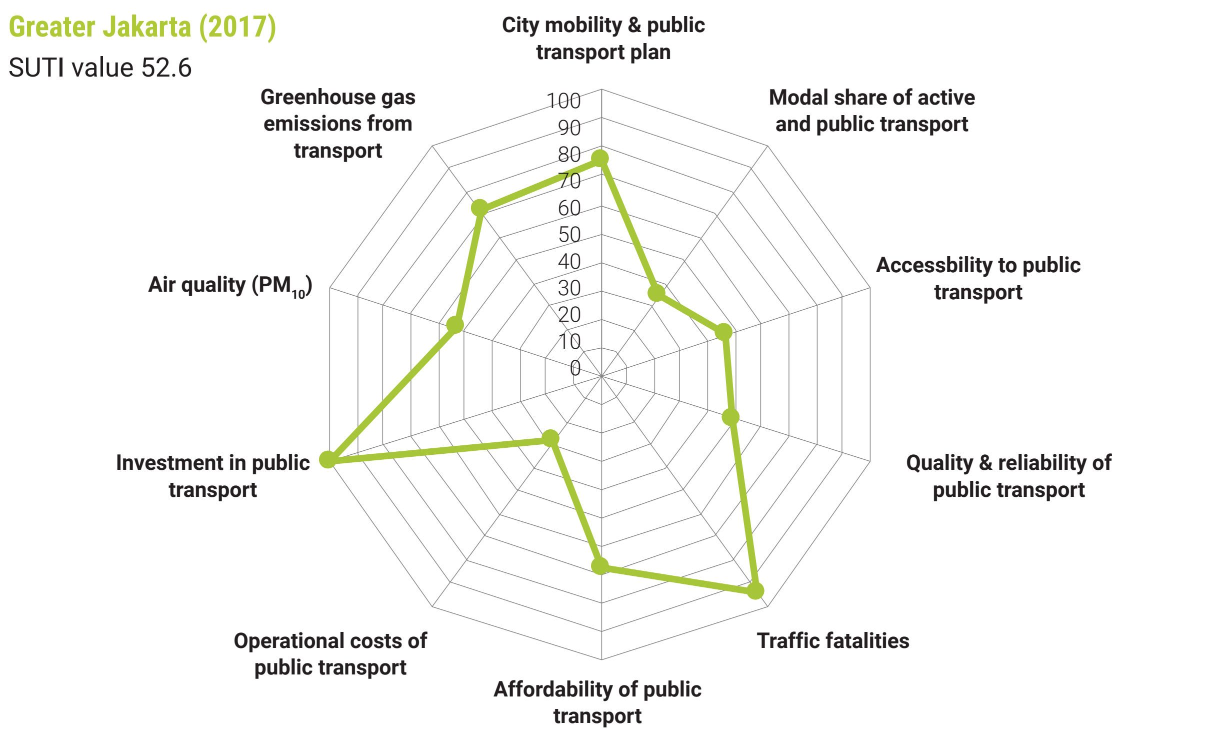
The SUTI analysis for Greater Jakarta show that the aggregate SUTI score increased from 52.6 in 2017 to 55.24 in 2020[2] (Figure 4.3). The improvement was mainly due to an increase in the score of public transport plan (Indicator 1), quality and reliability of public transport (Indicator 4) and improvement of environmental indicators, namely improvement of air quality and reduction in GHG emissions, though this could be partly due to the COVID-19 pandemic. The investment in public transport remained high in Greater Jakarta as the MRT and LRT lines came into operation and additional construction still ongoing. After COVID-19, the city has also invested in cycling infrastructure and pedestrian facilities.

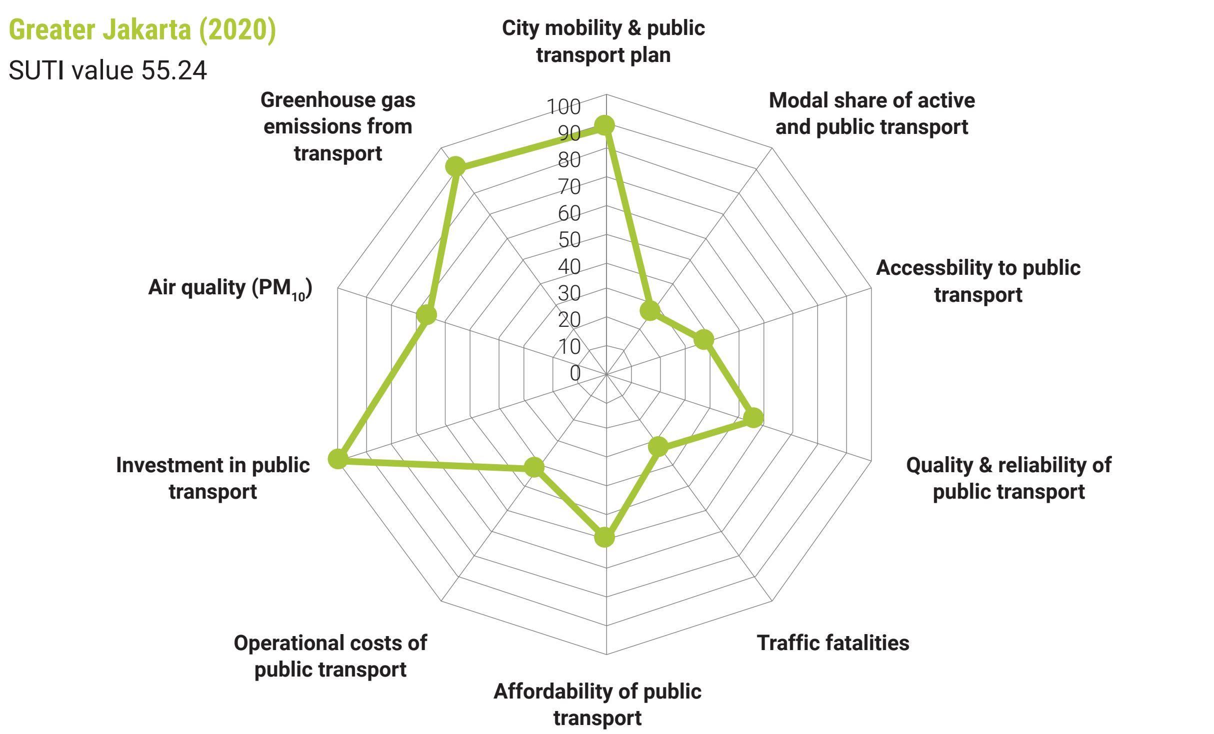
However, the city also saw some decrease in the performance of other indictors. Most importantly, the mode share of public and active transport decreased, accessibility decreased, affordability of public transport decreased, and cost recovery of public transport operations was lower in 2020 – this could be due to the loss of commuters during COVID-19. The traffic fatality per 100,000 population was also higher in 2020. This could be realistic, as the fatality figure of 2 per 100,000 population in 2017 was too good to be true. The two spider diagrams illustrate the relative performance of the city across the ten indicators in Figure 4.3.

Greater Jakarta is crippled with severe traffic congestion during peak hours. There should be some policy measure to discourage private vehicles and two wheelers. The paratransit (Angkot) also plays a major role in providing mobility services in the city. The city authority should accelerate the construction of mass transit systems and work to increase the mode share of public transport, based on the Greater Jakarta Public Transport Plan. Greater Jakarta Transport Authority is coordinating the improvement of public transport and intermodal transfer stations. The extension of mass transit and BRT routes would improve the accessibility of public transport in Greater Jakarta.

[2] Resdiansyah, 2021

Figure 4.3 SUTI Indicators for Greater Jakarta 2017 and 2020





4.5.4 Ulaanbaatar

The SUTI analysis for Ulaanbaatar in 2018 and 2021 surprisingly shows that the SUTI score decreased to 33.61 in 2021 from 39.09 in 2018 (Figure 4.4). This was mainly due to deterioration in quality and reliability of public transport (Indicator 4), and lower cost recovery (Indicator 7) due to loss of patronage after COVID-19. The two spider diagrams illustrate the relative performance of the city across the ten indicators.

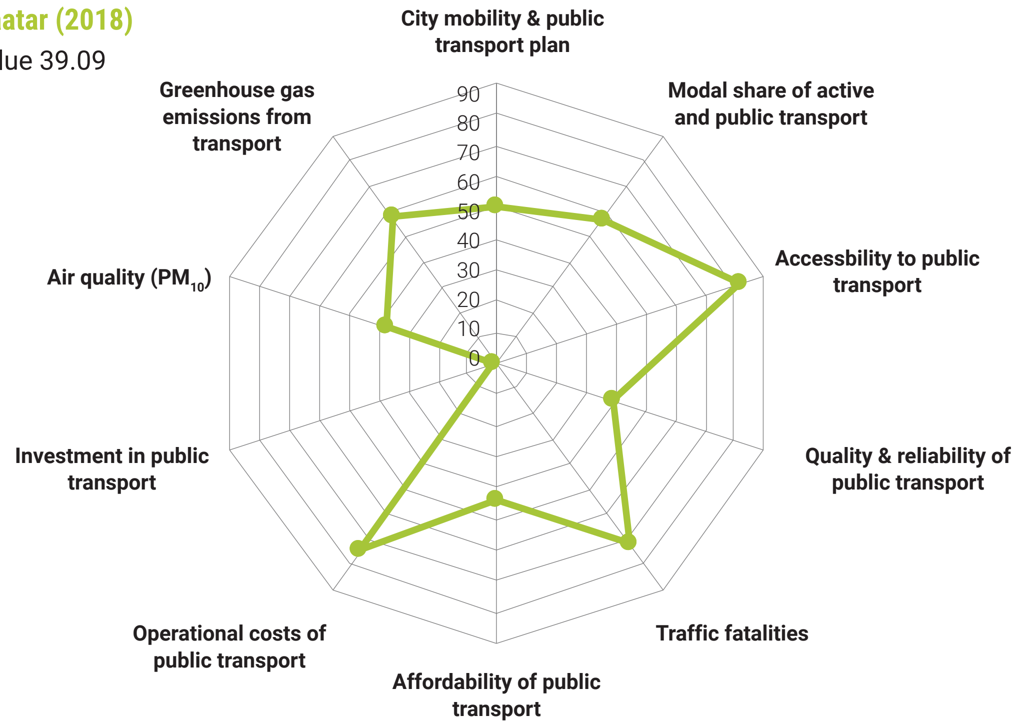
Compared to 2018, in 2021 there was no change in values of indicators 1, 2, 8, 9 and 10. The share of investment in public transport was very low, as much of the transport investment was for road infrastructure (it is worth noting that there was some recent investment made in procurement of public buses in 2022, but this was not included as the analysis was for 2021). The score of 8/16 for public transport planning can be considered high as the city has not yet decided on a type of mass transit system, despite discussions on LRT and many studies. It appears that the city has abandoned the plan to develop a BRT despite funding commitments. There have been delays in decision making. There should be some policy or disincentives for owning big cars, as the city is already crippled by severe peak hour traffic jams.

The city authority should act decisively on improving public transport systems in Ulaanbaatar in order to reverse the trend of diminishing sustainability. A new household survey is needed to reveal the actual mode share of public transport. There should be efforts to improve the quality and reliability of public transport services and extend their reach to outer Ger areas.

Figure 4.4 SUTI Indicators for Ulaanbaatar 2018 and 2021

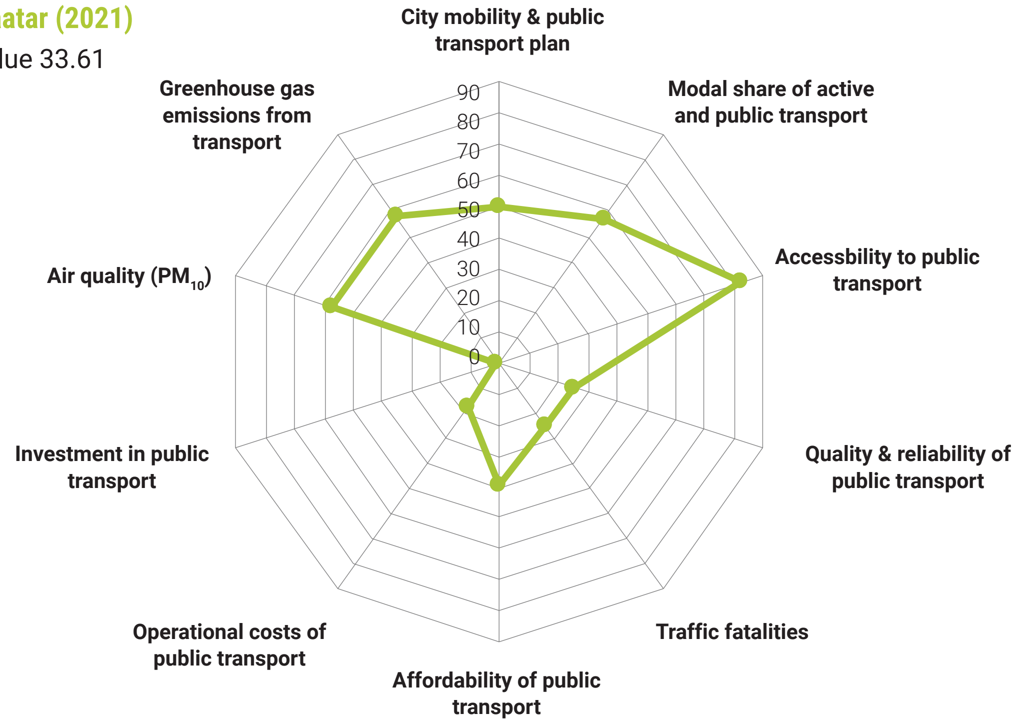
Ulaanbaatar (2018)

SUTI value 39.09



Ulaanbaatar (2021)

SUTI value 33.61



4.5.5 Colombo

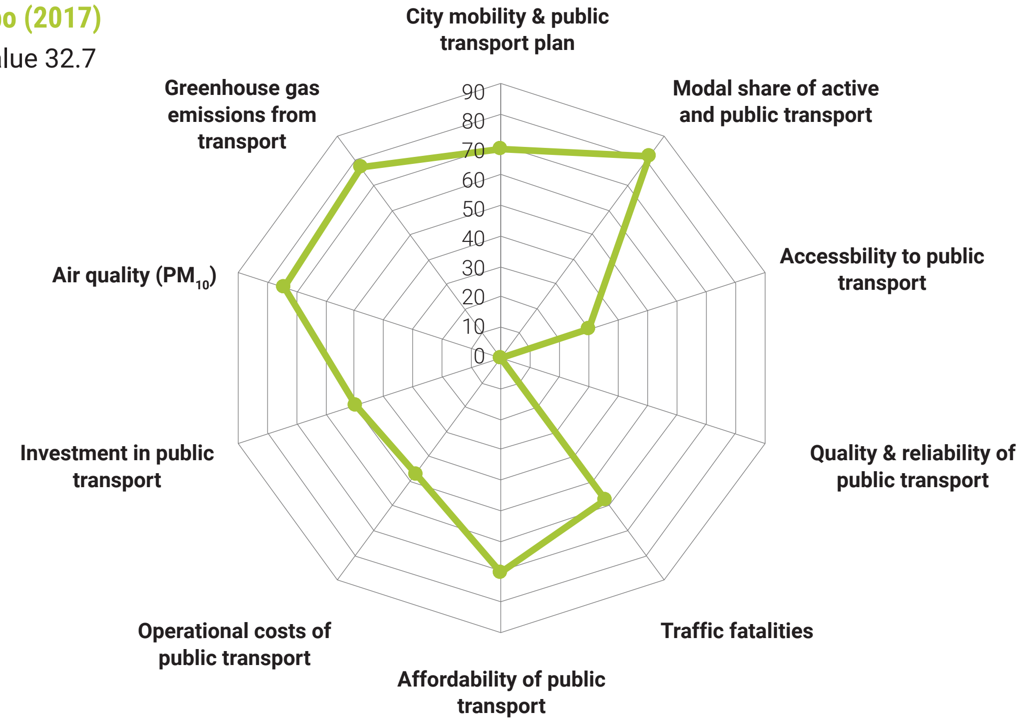
The SUTI analysis based on data collected in 2017 and 2020 shows the current state of urban transport in Western Region of Sri Lanka. The spider diagram illustrates the relative performance of the city across the ten indicators. The geometric mean of the SUTI score in 2017 was 32.70, while it increased to 41.96 in 2020 (Figure 4.5). This indicates that there is an overall improvement compared to 2017 results. However, Indicators 1, 2 and 8 declined in 2020 as compared with 2017. This outcome is linked to the cancellation and delay of public transport investments by the current government. The poor performance on these indicators shows that the city is going backwards in providing solutions for the congestion in the city. The score of the public transport planning indicator has gone down from 11/16 in 2017 to 7/16 in 2020. The mode share of active and public transport in commuting has also decreased from 75.45 per cent in 2017 to 69.4 per cent in 2020.

A better performance can be seen with Indicators 9 and 10, suggesting that the city has become more environmentally friendly with respect to the improvement in air quality and decrease of GHG emissions. Air quality improved from 46.00 $\mu g/m^3$ in 2017, to 21.82 $\mu g/m^3$ in 2020. Greenhouse gas emissions from transport improved from 0.63 CO_2 tons per capita in 2017 to 0.36 CO_2 tons per capita in 2019. However, it should be noted that national data was used to calculate GHG emissions for 2020 due to inadequate provincial level data. Moreover, operational costs of the public transport systems show an increase in 2020 while the affordability (travel cost) also increased in 2020 compared to 2017. Indicator 2 shows a concerning drop reflecting the decreasing trend in public transport usage, which may be related to the lack of developments in upgrading the public transport network. Meanwhile, access to public transport is largely unchanged, while traffic fatalities decreased in 2020 compared to 2017.

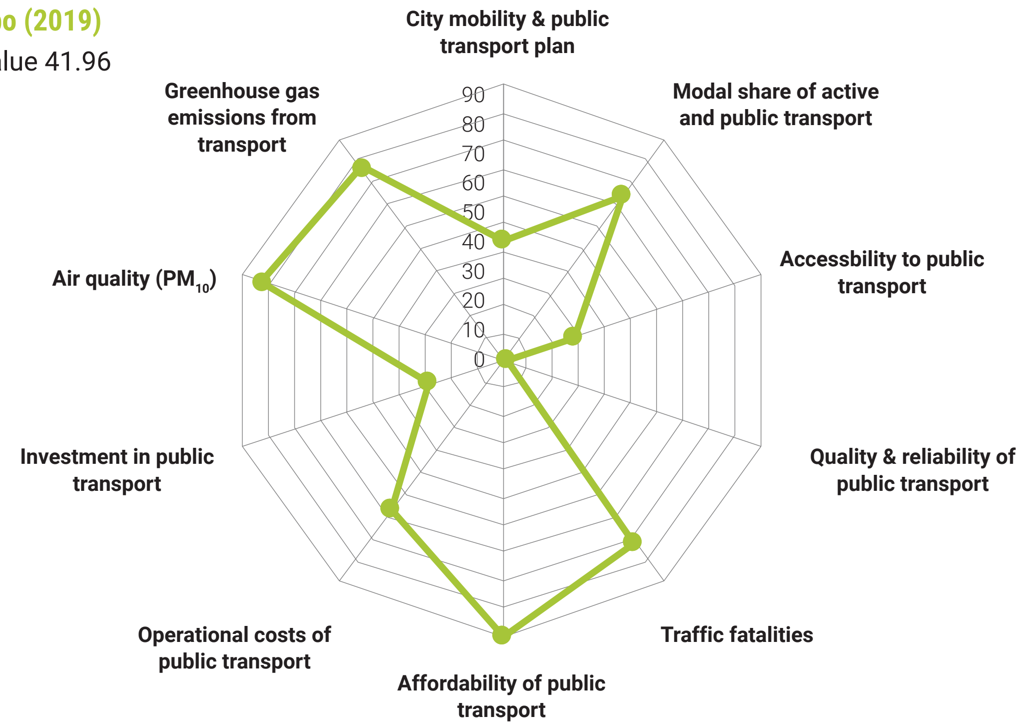
When considering the general consistency of performance, the results vary across the indicators from very poor to excellent. Strong inconsistency offers clues about the areas to focus more on than others in the future. A more even performance could suggest that the city generally follows a balanced approach in its management of the transport system.

Figure 4.5 SUTI Indicators for Colombo 2017 and 2019

Colombo (2017)
SUTI value 32.7



Colombo (2019)
SUTI value 41.96



4.6 Summary and review of results

This chapter reaffirmed the diversity of transport contexts in Asia-Pacific cities. Overall, Metro Manila and Surat seem to have the best performance, while Jaipur has the lowest SUTI value. While the overall performance of public transport and active mobility systems is below the desired level in all cities (except Dhaka and Colombo), most cities have plans to invest in sustainable mobility.

All cities show 'good' performance in terms of Indicator 10 (GHG emissions) and Indicator 6 (affordability). While these results are positive, they are likely to change dramatically with rapid motorization and the urban sprawl experienced in many Asian cities. It is also notable that these are on a relative scale and their magnitude in absolute scale is significant. Efforts to maintain and improve upon current levels are required.

Mobility assessments using SUTI were carried out in two different years for Colombo, Greater Jakarta, Hanoi, Kathmandu and Ulaanbaatar. The assessment results show a general improvement in the overall SUTI score for Colombo, Greater Jakarta, Hanoi, and Kathmandu. But surprisingly, for Ulaanbaatar the SUTI score was lower in 2021 (33.61) than in 2018 (39.09). This was mainly due to the deterioration in the quality and reliability of public transport, loss of patronage after COVID-19, and a lower farebox ratio as a result of economic hardship faced by commuters. In summary:

- The results for Hanoi show that there was an overall improvement in performance, but focus needs to be given to environmental aspects, especially the release of particulate matter and greenhouse gas emissions.
- In Kathmandu, the city's SUTI scores improved between 2017 and 2019. There was improvement in planning, accessibility and investment in public transport.
- Colombo has improved with respect to road safety and air quality. However, government initiatives on improving public transport systems have gone down between 2017 and 2020, and the performance of the public transport system has also declined. Attention to public transport needs to be maintained in order to improve the transport sector.
- Mashhad showed some polices with respect to social inclusion, such as the allocation of seats for women and women only coaches.
- The analysis also noted some steps towards the potential for using renewable energy in transport, in the sense that Metro Manila, Greater Jakarta, and Kathmandu are shifting towards electric mobility.

4.7 Learning from the sustainability assessment

The overall SUTI analysis helped with systematic assessment of the ten indicators. Many national focal points and urban transport experts faced challenges in collecting the data, and the coordination with related authorities was a major issue. In some cases, city level safety and emissions data were not available and national data were used.

The strength of SUTI lies in comparing the performance of urban transport in a city over a period of time. Even though comparisons among cities should be done with caution, looking at cities of similar size and context could instill competition to improve the overall index value and focus policy attention on indicators with low scores.

One of the objectives of SUTI is to encourage cities to undertake self-assessments over time and track their own performance. In this regard, the organization of annual regional workshops on urban mobility provide opportunities to share information and learn from each other. Inclusion of SUTI in the new Regional Action Programme and calls to expand its application are also encouraging. Observations from participating cities include the suggestion of separating the mode share of public transport and active mobility; the inclusion of gender disaggregated data as well as social inclusion; and the inclusion of an indicator reflecting the use of renewable energy in transport.

The next chapter provides general conclusions and recommendations for improving urban mobility based on the SUTI assessments of urban mobility conducted during last five years.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CONCLUSIONS AND RECOMMENDATIONS 5

Due to rapid urbanization and motorization, cities in Asia and the Pacific are facing a variety of transport challenges. Planning for sustainable urban transport is therefore increasingly becoming a priority for many cities and countries. However, achieving sustainability is not an easy task and cannot be attained overnight. It needs consistent efforts by cities and countries over a long period of time. The right mix of planning strategies, supported by a variety of instruments, can help cities achieve sustainable urban mobility.

As can be seen from the discussions in Chapters 3 and 4, the SUTI can be used to evaluate the sustainability of urban transport systems in cities, as well as to make comparisons with other cities. This chapter concludes with some general recommendations, based on observations from the assessment of urban mobility using the SUTI tool. It also touches upon ways in which SUTI can incorporate issues such as social inclusion and resilience of public transport systems, which have become prominent issues in the wake of the COVID-19 pandemic.

5.1 Comprehensive and integrated urban transport planning

The findings revealed that most cities have developed urban transport plans. However, many of these plans failed to include all public transport options, intermodal transfer stations and infrastructure for non-motorized transport. Some cities did not even have an approved urban transport plan. Short-term and piecemeal approaches will not be adequate to solve transport issues; cities should be planning for the future, taking into account the growing urban population and diverse mobility needs across sectors. In other words, cities need a comprehensive and integrated citywide mobility plan with short-, medium- and long-term implementation strategies. Furthermore, cities in Asia have distinctive transport systems, with various forms of paratransit or intermediate public transport modes . These modes should also be part of their integrated mobility plans. It is crucial to adapt interventions to match the local context carefully, as these modes cater to the specific needs of people in lower economic income groups and provide accessibility to jobs and services.

5.2 Implementing strategies to increase public transport usage

Even when cities have public transport services, the public transport mode shares in some cities, such as Phnom Penh, Surat, Surabaya, Hanoi, and Islamabad, are extremely low. These cities in particular need to implement strategies to increase the share of public transport and attract more commuters to use public transport. Cities should initiate pricing measures to discourage the use of private vehicles and push users to sustainable public transport modes. Also, accessibility and coverage of public transport is still poor in many cities; public transport services need to be extended to cover wider city areas. Apart from a few cities, the quality and reliability of public transport was rated low by passengers. The feedback received from user satisfaction surveys should be used to improve the quality and punctuality of public transport services in cities. Training of drivers, being courteous to commuters, regular cleaning of vehicles, improving bus stops, improving punctuality of operation and providing adequate information to commuters, are just some of the measures which could attract more customers to public transport modes.

5.3 Investing in public transport

Cities and countries are investing in public transport, but the results are yet to translate into better services and greater use of the system. For example, Greater Jakarta, Manila, Bangkok and Dhaka are investing in mass public transport systems. On the other hand, many cities are finding it difficult to decide on a suitable type of mass public transport system due to their high cost. For examples, cities like Kathmandu and Ulaanbaatar are still discussing what type of mass public transport system would best fit the local context. Further, many cities have a poor safety record and investment would be needed to improve the safety of public transport operations.

Given that many countries in Asia are developing their economies, they may be aware of sustainable transport strategies but unable to implement them for lack of funding. Therefore, it is important for governments and cities to explore various financing options to develop public transport systems. Innovative funding strategies such as private sector partnerships along with public funding should be made available to cities. Funding can also come from grants and loans from multilateral development banks and bilateral agencies of other countries. Since funding is limited, cities also have to prioritize between various sustainable transport strategies. Cities should invest in strategies that are low-cost and at the same time provide maximum benefits, such as building NMT infrastructure, improving safety, enhancing/improving bus services over cost intensive metro systems, etc. Each investment proposal must also be carefully analyzed to select the best projects, and the financing strategy should ensure financial feasibility and returns on investment. Financial risk analysis techniques such as payback period analysis, cost benefit analysis, financial statement modeling, etc. should be employed for informed decision making. With regards to the key challenges for financing low carbon projects, stakeholders identified lack of prioritization of sustainability by financial decision-makers and the high costs of financing such projects.

5.4 Improving the financial sustainability of operations

The analysis revealed that public transport fares are affordable in most cities. The share of public transport costs out of the total income for lower quantile income groups ranges from highly affordable to moderately affordable. Except in a few cities such as Bhopal, Suva and Kathmandu, however, public transport services are heavily subsidized by either the city or federal government (50 per cent or more in some cities). It was learnt that the public transport fare is a very sensitive issue for authorities, and that in some cities the fare has remained unchanged for the last seven years. To improve the quality of services and reduce the burden on authorities, authorities are advised to review their public transport fares. Non-revenue approaches could also be considered to enhance the financial sustainability of public transport operations. Given the high share of subsidies given to public transport operations, authorities may need to consider more aggressive marketing approaches to attract more commuters to public transport.

5.5 Planning for inclusiveness

Urban transport systems are a public good and should be physically and financially accessible to all sections of the society, especially vulnerable groups. A successful approach requires a comprehensive and coherent approach focussing on people's mobility and addressing social inclusiveness. Ensuring representation and participation of all sections of society in decision making processes through public consultations is a starting point. Building public transport infrastructure and services that are responsive to the needs of vulnerable people should be considered during the planning and construction stage. The needs of various socio-economic groups such as women, people with disabilities, aging population, urban poor, and marginalized communities must be taken into account and addressed. Universal access facilities, public transport network penetration to parts of cities where the poor reside, adopting public transport pricing strategies which consider affordability for economically weaker groups, providing safe and secure transport facilities for women, and providing special travel information for passengers with vision and hearing disabilities, are just some considerations that need to be taken up by cities to ensure inclusiveness.

5.6 Enhancing the capacity of city agencies and public transport operators

Technical capacity deals with whether officials and agencies have the capability to plan and implement programs to achieve sustainable urban mobility. The capability of city agencies and other stakeholders is a key factor in deciding the degree of success for various transport programs, as it determines whether they can plan, implement and manage strategies effectively. The cities should be supported to develop the capacity to explore and analyse innovative strategies, adopt new technological advancements and use data to make informed decisions regarding urban planning. Separate budgetary allotments should be kept aside to train city agencies and public transport operators. The capacity of officials should be enhanced to collect and analyse data so that they can monitor the periodic progress against key performance indicators such as mode share, accessibility, air quality, level of congestion, safety and overall commuters' satisfaction.

5.7 Enhancing the environmental sustainability of urban mobility

The analysis shows that many cities in the region still have poor air quality and increasing greenhouse gas emissions from transport. Push and pull policies to shift to public transport and reduce the use of private vehicles would help to tackle these issues. Some policies that can be employed are reduction of travel demand, development of mass public transport systems, increasing the vehicle occupancy rate, improving energy efficiency of transport, promotion of electric mobility, and carbon pricing. Some cities have effectively employed congestion pricing and low emission zones to internalize congestion and emissions and to discourage private vehicle users. Cities and countries can use emerging technology to enhance the efficiency of transport operations, use of renewable energy, and transition to electric mobility in public transport. Further, as energy, transport and climate change are interrelated sectors, the involvement of transport ministries needs to be increased so that they can provide inputs to the preparation or updating of nationally determined contributions. Ideally, ministries should ensure that transport sector emissions reduction targets and adaptation strategies are specified. Additional efforts are also required to implement the pledged transport sector emissions reduction strategies, including city level targets and actions.

The Avoid-Shift-Improve (ASI) approach can help cities to shift toward environmental sustainability. "Avoid" strategies focus on land-use transport integration (transit-oriented development, high density city centres, mixed land-use, polycentric city development, etc.), and other instruments can situate work, education and recreation opportunities near residential areas and thereby shorten trip distances. "Shift" measures focus on achieving a modal shift in favour of sustainable modes such as active and public transport. It also signifies a shift to cleaner fuels such as renewables, electric, natural gas and biofuels. An integrated approach has to be adopted to achieve a balance between the various modes and fuels, resulting in sustainable and low-carbon transportation systems. "Improve" measures on the other hand focus on improving fuel and vehicle efficiency.

5.8 Enhancing the resilience of urban mobility

The experience of the COVID-19 pandemic offers city and national transport authorities the chance to rethink urban transport planning, making it resilient to disruptions and strengthening collaboration with other related sectors. Restoring commuters' trust in public transport is still important to recover pre-COVID-19 ridership levels. Walking and cycling proved important to improve resilience of transport during the pandemic. Investments in segregated cycle lanes and walking infrastructure should be continued. In addition, given the rise in frequency of climate events, building climate resilient public transport infrastructure is increasingly becoming prudent. Therefore, necessary changes in design and construction of transport infrastructure needs to be addressed. This is critical as transport systems act as lifelines during natural disasters, aiding the movement of search and rescue teams, essential items, medical teams, etc. Therefore, it is important to mainstream climate adaptation measures into transport infrastructure planning and operations. Building climate resilient infrastructure includes making adjustments to engineering specifications and alignments, incorporating associated environmental measures, adjusting maintenance and contract scheduling, and making climate adaptation an integral part of urban planning.

5.9 Regional cooperation and collaboration

The Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022-2026), adopted by the Ministerial Conference on Transport at its Fourth Session in 2021, includes priority thematic areas on low carbon transport and logistics, urban transport and inclusive transport and mobility. This includes activities to (i) extend the application of the sustainable urban transport index tool and assist members and associate members in improving urban transport and in tracking and comparing the sustainability performance of their urban transport systems, and (ii) promote integrated urban and transport planning for efficient, sustainable and resilient urban transport systems within the urban transport thematic area.

The sharing of experiences would be very useful in selecting appropriate mass transit options which are suitable for the specific size and characteristics of a city. The SUTI analysis can support evidence-based decision making and initiate policy measures to improve indicators with a low score. ESCAP and other development partners can enhance regional cooperation by supporting a regional forum for sharing experiences and policies, especially in the aftermath of COVID-19.

5.10 Ways forward

The results demonstrate that in terms of the global impact of urban transport, cities in Asia and the Pacific are well positioned with very low per capita GHG emissions. However, cities are performing well on some indicators but poorly on others. The situation is likely to shift onto an unsustainable trajectory if cities fail to recognise and address the challenges they currently face. In this regard, the SUTI application has enabled cities to identify the strengths and weaknesses in their urban public transport systems.

ESCAP is continuing to extend capacity building support to countries and cities in using the SUTI tool. During the second half of 2022, SUTI assessments were underway in more cities (Shah Alam, Malaysia; Bukhara, Uzbekistan; Darkhan, Mongolia; Pokhara, Nepal; Vientiane, Lao People's Democratic Republic; Chattogram, Bangladesh; Almaty, Kazakhstan; Dushanbe, Tajikistan; and Baku, Azerbaijan). The results of these activities will continue to be published on the ESCAP SUTI website at https://www.unescap.org/kp/2021/sustainable-urban-transport-index-suti. The SUTI city mobility assessment reports which formed the basis for this study, presentations made at the workshops, and other related documents are also available from this website. Guided by these results, cities should take concerted actions and policies to enhance the sustainability, inclusiveness and resilience of their public transport systems.

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[54] Regmi and Pojani, 2022

[55] Regmi and Schwanen, 2021

[56] https://www.unescap.org/kp/2022/building-back-better-passenger-transport-asian-cities-after-covid-19

[57] Ministerial Declaration and Regional Action Programme, available at https://www.unescap.org/kp/2022/ministerial-declaration-and-regional-action-programme-sustainable-transport-development

[58] ESCAP, 2021

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