



Economic and Social Commission for Asia and the Pacific
Committee on Transport**Fifth session**

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Major issues in transport**Assessment of urban transport systems and services****Note by the secretariat***Summary*

The Asia-Pacific region is rapidly urbanizing, and the growth and concentration of motor vehicles in urban areas have led to increased demand for better urban mobility. In order to achieve Sustainable Development Goal target 11.2, renewed commitments from member States and cities to improve urban mobility in the region are required.

The present document contains an outline of the status of urban transport systems and services in the region and information on the sustainable urban transport index for cities in Asia and the Pacific, as well as the results of and progress towards its application. Challenges and issues related to intelligent transport system applications are also reviewed, as are cases of their use to address urban transport issues.

The Committee on Transport is invited to endorse the sustainable urban transport index as a tool to measure the sustainability of urban transport systems and services in cities and track improvements over time. The Committee may also wish to encourage members and associate members to use the index in major, secondary and emerging cities of the region.

The Committee may wish to acknowledge the potential advantages, challenges and issues regarding the development of intelligent transport systems. The Committee may also wish to support the planned activities on developing policy recommendations on the deployment of intelligent transport systems to overcome regulatory challenges and issues.

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** ESCAP/CTR/2018/L.1.

I. Introduction

1. The Asia-Pacific region has witnessed rapid population growth and urbanization. In 2016, half of the world's 4 billion urban dwellers lived in the region, and today 19 of the world's 31 megacities are in the region. According to recent projections, by 2030 urban population in the region will reach 2.7 billion (56 per cent of total population), and by 2050 this number will reach 3.2 billion (63 per cent urban share).¹
2. Urban centres play an important role as transport hubs. Dealing with transport issues in urban areas is complex due to various operating modes, diverse travel patterns and the magnitude of traffic volumes.
3. Efforts to address urban traffic issues have traditionally focused on providing more facilities and services to vehicle users. Given that cities are transport points for the movement of both humans and freight, urban transport systems and services are intricately linked to urban forms and spatial structures. Traditional approaches to traffic management could be revisited with a new urban mobility paradigm resulting from evolving urban transport modes and smart technologies, including intelligent transport systems.
4. The New Urban Agenda² emphasized the urgent need to tackle urban transport challenges. In the annex to the Ministerial Declaration on Sustainable Transport Connectivity in Asia and the Pacific,³ endorsed by the Economic and Social Commission for Asia and the Pacific (ESCAP) in its resolution 73/4, it was acknowledged that the major urban transport challenges member States and cities in the region faced included extending coverage, managing congestion, reducing emissions and air pollution, enhancing safety and ensuring affordability. Also recognized was the role of new technologies in increasing the efficiency, safety and effectiveness of transport systems.
5. The present document contains information on the status of urban transport systems and services in the region and on the sustainable urban transport index for cities in Asia and the Pacific, as well as the results of and progress towards its application. Challenges and issues related to intelligent transport systems applications are also reviewed, as are cases of their use to improve the operational efficiency of urban transport systems in region.

II. Current status of urban mobility

A. Urban traffic issues and opportunities

6. The Asia-Pacific region has witnessed rapid motorization. Most countries showed growth in the motorization rate (number of vehicles per 1,000 inhabitants) from 2014 to 2015. The rate in highly motorized countries, such as Australia, Japan, New Zealand and the Republic of Korea increased from 402–796 in 2014 to 417–819 in 2015, and the rate in less motorized countries, such as India, Pakistan, the Philippines and Viet Nam, increased from 20–36 in 2014 to 22–38 in 2015.⁴

¹ *Statistical Yearbook for Asia and the Pacific 2016: SDG Baseline Report* (United Nations publication, Sales No. E.17.II.F.1).

² General Assembly resolution 71/256, annex.

³ E/ESCAP/73/15/Add.1.

⁴ International Organization of Motor Vehicle Manufacturers, "Vehicles in use", 2015.

7. This rise in vehicle ownership has led to traffic congestion, with negative impacts in urban areas, such as economic losses and an increase in energy consumption and air pollution. In 2016, Asian cities experienced severe traffic congestion, with a 30 to 50 per cent increase in overall travel times when compared to a free-flow situation. Bangkok (61 per cent), Jakarta (58 per cent) and Chongqing, China, (52 per cent) had the worst traffic jams.⁵

8. In addition to the growing number of private vehicles, other characteristics of cities in South Asia and South-East Asia are that powered two wheelers constitute a major share of vehicle population. For example, India, Indonesia, Thailand and Viet Nam have very high numbers of motorcycles. Due to growing numbers of private vehicles and the lack of reliable public transport systems, regional cities and member States are finding it difficult to attract more commuters to public transport systems as well to keep its mode share.

9. Road fatalities among vulnerable road users, namely motorcyclists, cyclists and pedestrians, and urban road safety are a cause of concern in the region. Road traffic deaths among vulnerable road users account for 55 per cent of total road traffic fatalities.

10. Time losses and transport costs from road congestion impose an economic cost of 2 to 5 per cent of gross domestic product in the region every year.⁶ As of 2017, Asian non-Organization for Economic Cooperation and Development countries, including China and India, accounted for more than 70 per cent of the increase in transport fuel consumption, due to increases in personal mobility.⁷ For the period 2008–2013, only 5 of 24 Asia-Pacific countries had data available that showed they met the recommendation of the World Health Organization on the annual mean concentration of particulate matter of 2.5 micrometres in cities.^{8,9}

11. The use of advanced information and communication technology, including smart mobile devices, wireless telecommunications and computing systems, has helped to address some urban traffic issues as a form of an intelligent transport system. In the absence of long-term strategies for integrated land use and urban transport planning, the application of intelligent transport systems could address such urban traffic issues quickly with immediate results. Further, newer technologies using big data analytics, connected and automated vehicles, and the concept of smart cities with smart mobility have attracted policymakers' attention as potential solutions to urban traffic issues. With an increasing number of national or local initiatives, demand for the development of intelligent transport systems is growing in the region.

⁵ Tomtom Traffic Index. Available at www.tomtom.com/en_gb/trafficindex/list?citySize=LARGE&continent=AS&country=ALL (accessed on 1 August 2018).

⁶ Asian Development Bank, *Sustainable Transport Initiative: Operational Plan* (Manila, 2010).

⁷ United States of America, Energy Information Administration, *International Energy Outlook 2017* (Washington, D.C., 2017).

⁸ The annual mean concentration of dangerous fine particulate matter, of 2.5 micrometres or less, should be less than 10 micrograms per cubic metre of air.

⁹ *Statistical Yearbook for Asia and the Pacific 2016*.

B. State of urban mobility

12. Popular forms of urban public transport modes in the region's cities include buses, bus rapid transit, elevated rail, light rail transit, mass rapid transit, para-transit, urban railways, taxis and trams. Boats and ferries are also common modes of transport along inland waterways.

13. Bus rapid transit is a popular form of public transport in the world, and it continues to be a favoured system of mass transit in Asia for its relative ease of use and low installation costs. Currently, 43 Asian cities operate 1,593 kilometres of bus rapid transit carrying approximately 9.3 million passengers per day.¹⁰ The Tehran bus rapid transit system has the highest capacity, at 2 million passengers per day, while the Jakarta bus rapid transit system is the longest in the world, at 207 kilometres.

14. The region also has many rail-based public transport systems, such as light rail transit and mass rapid transit. Cities such as Beijing, Guangzhou and Shanghai in China, Moscow, Tokyo and Seoul have more than 300 kilometres of rail-based urban transport networks. New construction of rail-based urban mass transit systems is progressing in many Chinese and Indian cities, some Iranian cities (Ahvaz, Karai, Kermanshah and Qom), as well as in Bangkok, Dhaka, Hanoi, Ho Chi Minh City, Viet Nam, Jakarta and Lahore, Pakistan.

15. In general, the efficiency and state of urban public transport are gauged by ridership and modal share. The mode share of public transport is high in some Asian cities, such as Manila (59 per cent), Colombo (53 per cent), Hong Kong, China (52 per cent), Mumbai, India (45 per cent) and Singapore (44 per cent). While Kathmandu (28 per cent) and Jakarta (27 per cent) have a moderate public transport mode share, other major cities such as Ho Chi Minh City, Viet Nam (2 per cent), Hanoi (7 per cent), Kuala Lumpur (7 per cent) and Tehran (13 per cent) have a lower public transport mode share.^{11,12}

16. Inner city para-transit systems are often found in this region, providing personalized, flexible and affordable public transport services. Para-transit comes in various forms, including vans, minivans, tempos, electric three wheelers, motorcycle taxis, minibuses and customized public pickups (for example, *ankots* in Indonesia, tempos in Nepal, *songthaew* in Thailand and *jeepneys* in the Philippines).

17. Non-motorized transport, such as walking and cycling, is also gaining popularity in the region. Member States and city authorities are developing infrastructure for non-motorized transport and promoting car-free days as part of their comprehensive mobility plan. Bicycling has been growing and various forms of public bicycle sharing are emerging in China, Japan, India, the Philippines, the Republic of Korea, Singapore and Thailand.

18. In order to enhance the energy efficiency of the transport sector in the region, regulations that support the use of hybrid and electric passenger vehicles are also gaining popularity, resulting in changes such as public electric plug-in stations. Recent examples of energy efficient vehicles include the popular electric rickshaws (a new form of para-transit) in Nepal and Hanoi,

¹⁰ Global BRT Data. Available at www.brtdata.org/ (accessed on 1 August 2018).

¹¹ "Sustainability measures of urban public transport in cities: a world review and focus on the Asia/Middle East region", *Sustainability* 2017, vol. 9, No. 1 (January 2017).

¹² City reports available at www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti.

and a fleet of electric buses operating in the central core of Ho Chi Minh City. The Government of Nepal, in its energy white paper, envisages policies to promote the use of electric vehicles and the development of charging stations and infrastructure. It aims to increase the import share of electric vehicles to 50 per cent in five years (by 2023) and the Energy Minister is currently using an electric vehicle.¹³

19. There is much agreement and consensus among urban transport experts and policymakers on how to plan, develop and operate urban transport systems and services, including the use of emerging technologies. Some of these policies are improving the quality and extent of mass urban public transport systems, integrating various urban transport modes, prioritizing non-motorized transport, encouraging the construction of intermodal transfer stations, promoting the use of integrated ticketing and smart card systems, and restricting the use of private vehicles.

20. The following is a description of a few innovative policy measures and projects to improve urban mobility implemented by member States and cities:

(a) **Suroboyo Bus.** This is an awareness campaign for public transport and waste management in Surabaya, Indonesia. A fleet of eight large, red, low-floor public buses operates between Purabaya Terminal and Rajawali Street, covering 44 stations. It operates with a five-minute headway and each bus has a capacity of 67 passengers. The buses have assigned seats for women and priority citizens. To get a single-ride sticker for this bus route, passengers need to bring empty plastic bottles, either six small bottles or three large bottles. Bus stops are equipped with facilities to collect recyclable plastic bottles and ride stickers. This awareness campaign for recycling plastic waste and promoting bus service is gaining popularity; as a result, the city authority is planning to add 10 more similar buses to the existing fleet by the end of 2018 and extending the service to other routes;¹⁴

(b) **Purabaya Intercity Bus Terminal.** The government of Surabaya has developed a state-of-the-art intercity bus terminal at Purabaya for the smooth transfer of passengers from intercity and suburban buses to urban buses. In 2016, the terminal handled 16,151,715 arrivals and 16,071,055 departures, in 577,820 arrival and 575,794 departure buses. The well-designed terminal features bus information, ticketing booths, passenger waiting areas, kiosks, restaurants and two-level departure halls with an overpass leading to 25 intercity and suburban bus bays and 10 central city bus bays. The terminal is well managed and operated as the largest bus terminal in South-East Asia and is one of the busiest;¹⁵

(c) **Surat Sitalink public transport system.** Surat, India, has a public transport system featuring 102 kilometres of bus rapid transit network with 156 stations, 279 kilometres of regular city bus network, and 12 kilometres of high-mobility corridors. The ridership increased from 25,000 to 210,000 passengers per day over 18 months after its inauguration. The three systems are operated by a single private operator, Sitalink, with a common fare structure and transferable ticketing system. The Surat city

¹³ *Current Status and Future Course of Energy, Hydropower and Irrigation Sectors* (8 May 2018) (in Nepali only). Available at www.moen.gov.np/pdf_files/White-Paper-2075.pdf.

¹⁴ Information collected during a mission to Surabaya from 11 to 13 July 2018.

¹⁵ *Ibid.*

authority is planning a new bus depot, a smart ticketing card system, and new infrastructure for walking and cycling;¹⁶

(d) **Smart Cities Mission.** The provision of efficient urban mobility and public transport is a strategic element of the Smart Cities Mission launched by the Government of India in 2015. Key elements include traffic and transport management; universal design and barrier-free public transport facilities; strategies to increase walking and cycling mode shares; and urban planning strategies to reduce long-distance trips of private passenger vehicles, reducing air and noise pollution. Rail-based public transport is also a key component of the initiative, which completed 77 kilometres of a new metro network in the past three years and approved five new metro projects. Currently, there are 14 metro projects under construction in 12 smart cities in India.¹⁷

III. Assessment of urban transport systems and services

21. The provision of sustainable urban transport is becoming a major issue due to rapid urbanization worldwide, including in the Asia-Pacific region. The adoption of the 2030 Agenda for Sustainable Development,¹⁸ with its 17 Sustainable Development Goals, adds new impetus to efforts to address global development challenges, including urban transport. Sustainable Development Goal target 11.2 focuses on improving accessibility for all, with an emphasis on public transport.

22. Measuring the state of urban transport and evaluating urban transport policies and their implementation can support assessments of urban transport contributions to sustainable development. Increasingly, selected urban transport indicators and indices are useful for the assessment of urban transport systems and services and also reflect the state of urban transport performance among cities. There is, however, no established system of indicators and indices to measure, monitor and report on sustainable transport for cities in the Asia-Pacific region.

23. Within the urban transport theme included in the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017–2021), a study on the assessment of urban transport systems was envisaged. A collaborative research study was embarked on in 2016 to identify key urban transport indicators that could constitute an index to measure the sustainability of urban transport systems and policies in the Asia-Pacific context.

24. The concept of a sustainable urban transport index was presented at the Expert Group Meeting on Planning and Assessment of Urban Transportation Systems, held in Kathmandu in September 2016. The Meeting supported the concept and provided feedback on identifying indicators and developing an index. The Regional Meeting on Sustainable Urban Transport Index, held in Jakarta in March 2017, finalized the index and recommended that the Committee of Transport, at its fifth session, in 2018, consider endorsing the sustainable urban transport index for its regional application in Asian cities.

¹⁶ Information collected during a mission to Surat from 25 to 27 July 2018.

¹⁷ See India, Ministry of Urban Development, *E-Book* (March 2017). Available at <http://mohua.gov.in>.

¹⁸ General Assembly resolution 70/1.

A. Sustainable urban transport index

25. The sustainable urban transport index is a framework of 10 indicators for the assessment of urban transport systems and services as well as the state of urban transport performance in cities. Table 1 lists the 10 indicators, measurement units and normalization range.

Table 1
Indicators for the sustainable urban transport index

No.	Indicators	Measurement units	Weight	Range	
				Min.	Max.
1.	The extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	0–16 scale	0.1	0	16
2.	Modal share of active and public transport in commuting	Trips/mode share	0.1	10	90
3.	Convenient access to public transport service	Percentage of population	0.1	20	100
4.	Public transport quality and reliability	Percentage satisfied	0.1	30	95
5.	Traffic fatalities per 100,000 inhabitants	Number of fatalities	0.1	0	35
6.	Affordability – travel costs as part of income	Percentage of income	0.1	35	3.5
7.	Operational costs of the public transport system	Cost recovery ratio	0.1	22	175
8.	Investment in public transport systems	Percentage of total investment	0.1	0	50
9.	Air quality (particulate matter of 10 micrometres)	microgram/m ³	0.1	150	10
10.	Greenhouse gas emissions from transport	Carbon dioxide equivalent tons/capita/year	0.1	2.75	0
Total			1.00		

26. With these indicators, the index is a comprehensive assessment tool that incorporates urban transport systems and the social, economic and environmental dimensions of sustainable urban transport systems and services.

27. The indicators on urban transport plans and modal shares of active and public transport represent the urban transport system dimension. It will enable cities to evaluate how comprehensive their urban transport master plan is and whether the plan includes facilities for intermodal transfer, pedestrians and cyclists as well policies to increase public transport modal share.

28. The indicators on accessibility, road safety, quality and reliability of public transport, and affordability represent the social dimension of urban transport systems and services. Their assessment will enable cities to initiate policies to improve on those indicators.

29. The indicators on operational costs and investment in public transport systems represent the economic dimension. Their assessment will enable cities to evaluate the state of investment made in public transport and how the public transport service is generating revenue. Their assessment result will enable city authorities to initiate policies to increase investment in public transport and possibly to review fares.

30. Finally, the indicators on air quality and greenhouse gas emissions represent the environmental dimension. Their assessment will enable cities to evaluate the environmental impact of public transport systems. Policies on fuel quality, the use of alternate energy, emissions standards and vehicle maintenance will help to improve air quality and greenhouse gas emissions.

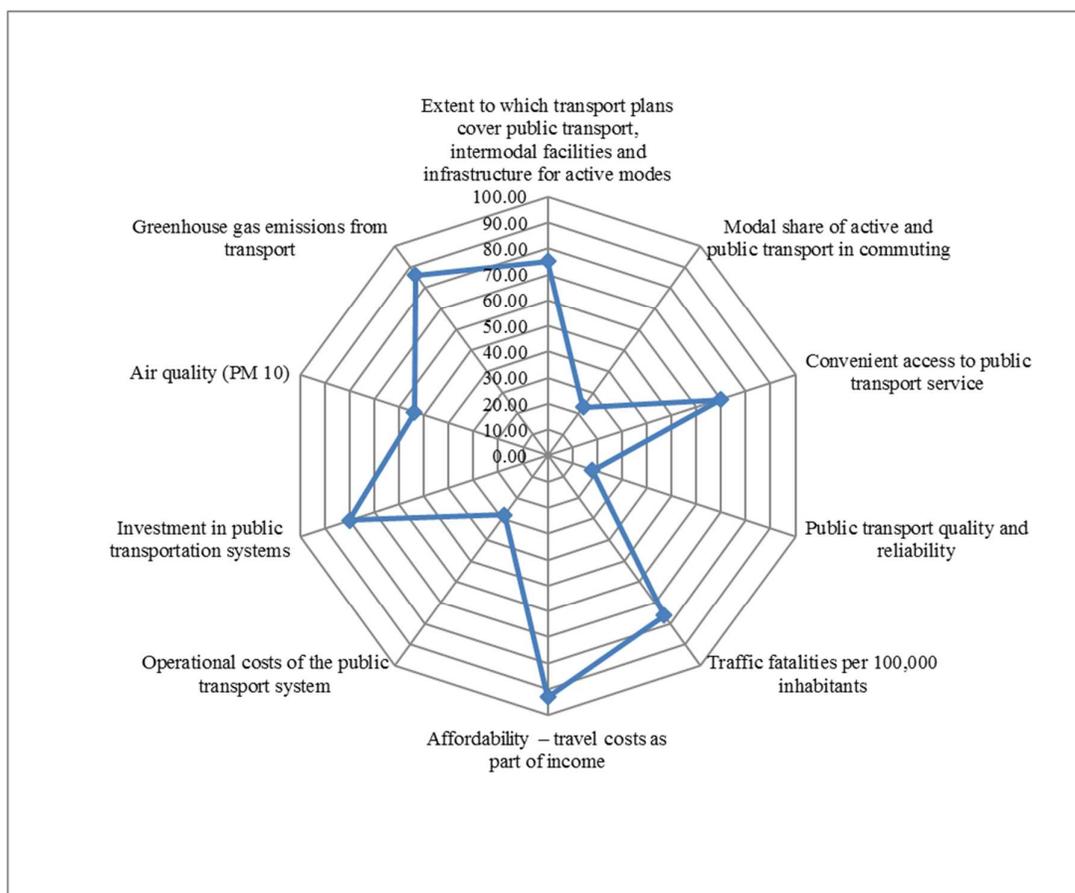
31. Indicators on different scales need to be normalized before comparison and aggregation are possible. The linear rescaling method that is applied for the index is a common approach in composite index design. This allows for a simple transformation to a linear scale of 1–100 for each indicator. The minimum and maximum ranges are defined as the lowest and highest value found or expected for each indicator based on real performance and information in the literature, with consideration given to the context of Asia and the Pacific. The index is derived by geometric aggregation of the 10 indicators and equal weightage is applied for all 10 indicators.

32. The most important factor in the application of the index is the availability of suitable, consistent and reliable urban transport data. Without data, even the most sophisticated index is useless. Data need to be collected using similar methods and need to be regularly updated. Therefore, additional efforts by city authorities are needed to collect and compile data for the 10 indicators.

33. One of the important user-friendly outputs of the analysis is the display of results in a spider diagram. The visual display of the state of each indicator in a city easily allows policymakers to comprehend the system and focus on the indicators which have low values (which will appear near the centre of the circle).

34. The figure below shows an example of a spider diagram wherein the state of each indicator can be observed. A high value (near the outer circle of the diagram) indicates good results, whereas the opposite is the case for a low value. Based on this result, the city could consider if there were areas where it would like to focus more, or areas where additional data should be required and examined more closely. Repeating the exercise at regular intervals would allow a city to track performance and results over time.

Sample spider diagram



Abbreviation: PM 10, particulate matter of 10 micrometres

35. Application of the index among similar cities based on standardized data collection approaches and methodologies together with comparisons of the results would enable cities to benchmark their performance against individual indicators as well as the index in order to assess the overall sustainability of their urban transport systems and services.

36. The index can serve as a quantitative tool for member States and cities of the region to assess urban transport systems and services. It can help to identify policy gaps and to prioritize the additional measures and investment strategies required to improve urban transport systems and services. It is expected that more cities and member States will gradually adopt standardized data collection methods and apply the indicators and index. The index can also serve as a tool to monitor progress towards the achievement of Sustainable Development Goal target 11.2.

B. Key findings from the pilot application

37. The pilot application of the index was conducted and completed in four cities in 2017: Colombo; greater Jakarta; Hanoi; and Kathmandu.

38. The secretariat supported each pilot city on data collection, provided advisory services and organized a consultation meeting in each city to discuss the data collection approach for the 10 indicators and the analysis and preparation of the report. The visits to the four pilot countries and cities took place from July to September 2017.

39. The pilot countries and cities designated a focal point to coordinate data collection and to prepare an analysis report. In order to support a standardized approach in data collection and analysis, a monograph series on the assessment of urban transport systems,¹⁹ a sustainable urban transport index data collection guideline²⁰ and a Microsoft Excel calculation sheet were developed and provided to the focal points. Despite the short project time frame, all four pilot cities were able to collect data for the 10 indicators and produced analysis reports.

40. The index number was 52.5 for greater Jakarta, 47.8 for Kathmandu, 32.7 for Colombo and 32.2 for Hanoi. A higher index number suggests a higher overall performance of assessment. Pilot city authorities have already started interpreting the results of the assessment and drawing implications for their urban transport planning policies.

41. The city authorities of greater Jakarta have been investing in two mass transit systems and have developed an integrated urban transport plan. The road safety indicator showed a good road safety situation. Based on the analysis, the greater Jakarta city authorities have identified that additional efforts are required in the following areas:

(a) To extend public transport accessibility, which is currently at 49 per cent;

(b) To increase the mode share of public transport, which is currently at 27 per cent;

(c) To improve air quality, including through strategies to reduce pollutant particles particulate matter of 10 micrometres or less, which was measured at 82 micrograms/m³, annual mean value, and exceeded World Health Organization guidelines (20 micrograms/m³) and was ranked one of the highest in the region.²¹

42. The analysis highlighted that Kathmandu had an improved road safety record and a relative high mode share of public transport, despite a low level of user satisfaction. The city authorities are developing a comprehensive urban transport master plan, incorporating walking and cycling infrastructure. Based on the analysis, Kathmandu city authorities have identified the need to take action in the following areas:

(a) Improving pedestrian facilities to address the high mode share of walking (40.6 per cent);

(b) Improving the quality and reliability of public transport systems (28 per cent public transport mode share);

(c) Increasing investment in the development of mass public transport systems;

¹⁹ ESCAP, *Monograph Series on Sustainable and Inclusive Transport: Assessment of Urban Transport Systems* (ST/ESCAP/2795).

²⁰ ESCAP, *Sustainable Urban Transport Index: Data Collection Guideline* (Bangkok, 2017).

²¹ Individual sustainable urban transport index city reports are available at www.unescap.org/events/capacity-building-workshop-sustainable-urban-transport-index-suti.

(d) Improving air quality, which regularly exceeds the National Ambient Air Quality Standard for Nepal (120 micrograms/m³ for particulate matter of 10 micrometres or less).

43. Colombo has a good urban transport master plan, a good public transport network, good air quality, low greenhouse gas emissions and affordable public transport fares. Based on the analysis, the government of Colombo has identified areas for further improvement, such as increasing the mode share, the accessibility, the quality and the reliability of its public transport services, which already enjoys a high mode share of 44 per cent. The government of Colombo is also planning to develop an elevated light rail transit system.

44. In comparison with other pilot cities, Hanoi has low greenhouse gas emissions and high affordability of and accessibility (60 per cent) to public transport as well as a relatively good road safety record. The Hanoi city authorities have identified the need to further increase the mode share of public transport and to improve air quality. Based on the analysis, more infrastructure for walking and cycling and intermodal transfer facilities could be incorporated into the already approved transport master plan. The government of Hanoi is developing two externally funded mass transit systems.

45. One interesting common feature of the assessment was that the fare structure of public transport was very low in all pilot cities. Often city authorities or the central government provided subsidies to the public transport operators, except in Kathmandu, where the private sector dominated the operation of public transport system.

46. A capacity-building workshop on the index was held in Colombo in October 2017, in collaboration with the Ministry of Transport and Civil Aviation of Sri Lanka, to share the results of the pilot study with the pilot cities and other related stakeholders and to consider ways to improve urban transport systems in Asian-Pacific cities. The participants in the workshop expressed their appreciation for the support given to their cities and found the data collection guideline and the Excel sheet very useful. The participants recommended that the index should be applied in additional cities.

47. During the pilot phase, the secretariat also collaborated with the Center of Excellence in Urban Transport in India, the Greater Jakarta Transport Authority, the Kathmandu Valley Development Authority, the Transport Development and Strategy Institute in Viet Nam, and the University of Moratuwa in Sri Lanka. To expand the index application to major, secondary and emerging cities of the region, new partnerships with related stakeholders are essential.

C. Further work on the application of the index

48. The secretariat collaborated with the Government of the Russian Federation to hold the High-level International Conference “City and Transport: Safety, Efficiency, and Sustainability” in Khabarovsk, Russian Federation, on 4 and 5 September 2017. The index was introduced, and the conference recognized the provision of public transport, non-motorized transport, electric and smart mobility, and the use of intelligent transport systems as essential components of sustainable urban transport systems.

49. The secretariat currently provides capacity-building support to six cities in the Asia-Pacific region (Bandung and Surabaya in Indonesia; Dhaka; Ho Chi Minh City, Viet Nam; Surat, India; and Suva) for the application of the

index. Advisory missions to five cities were completed in June and July 2018 and technical advice was provided to city focal points and city transport authorities for data collection and analysis.

50. The six new cities should complete the draft assessment by September 2018. A capacity-building workshop on urban mobility and the index will be held in Dhaka on 12 and 13 September 2018 in collaboration with the Ministry of Road Transport and Bridges and the Dhaka Transport Coordination Authority. Its objective is to share the cities' experiences, as well as to discuss policy measures to improve urban mobility in these cities and other Asian cities. In addition to the six cities, additional participants from other cities and member States are invited to attend.

51. To enhance the dissemination of information on the index, a brochure was developed and distributed at related events and during missions. The brochure is available in Chinese, English and Russian. An article on the index was published in the *Transport and Communications Bulletin for Asia and the Pacific*, No. 87, with the theme "Transport and the Sustainable Development Goals" and a blog post on the index was published.²²

52. As the data for the 10 indicators are readily available in most cities, cities are encouraged to use the index to assess urban transport systems and then use their findings to initiate and implement policy measures to improve urban transport systems and services. Further, the index includes aspects of planning, accessibility, modal share, the quality and reliability of public transport, safety, affordability, investment, and air quality and greenhouse gas emissions. The index has the potential to emerge as a global framework and tool for assessment of urban transport systems and services and to track progress towards achievement of Sustainable Development Goal target 11.2. The index was presented at the Asian Development Bank in November 2017 and at the Ninth World Urban Forum in Kuala Lumpur, in 2018, at a plenary session and at the urban library. The index was included in the *Sustainable Development Goal 11 Synthesis Report*²³ prepared for the high-level political forum on sustainable development of the United Nations, held at Headquarters in New York in July 2018.

53. The secretariat has explored collaboration and partnership opportunities with the World Business Council for Sustainable Development and the United Nations Human Settlements Programme. Further opportunities to collaborate with the Cities Alliance, the Association of Southeast Asian Nations Smart Cities Network, the Smart Cities Mission in India and other related stakeholders will be explored.

54. As urban transport is the domain of city authorities, a mayors' conference would be useful for wider dissemination of the index and the data collection and assessment guidelines. Also, to encourage cities to self-assess their urban transport systems using the index, a dedicated website for the index will be developed and a train-the-trainer programme for stakeholders is planned.

²² www.unescap.org/blog/tracking-the-progress-of-urban-mobility-in-asian-cities-using-the-sustainable-urban-transport-index.

²³ United Nations Human Settlements Programme, *SDG 11 Synthesis Report 2018: High-Level Political Forum 2018 – Tracking Progress Towards Inclusive, Safe, Resilient and Sustainable Cities and Human Settlements* (Nairobi, 2018).

IV. Urban utilization of intelligent transport systems

A. Definition and necessity

55. Intelligent transport systems are an overarching tool utilizing electronics, telecommunications and information technology to improve transport system operations, which contribute to increased efficiency, safety, productivity, energy savings and environmental quality.²⁴ The definition adopted by the Intelligent Transportation Society of America in 1998 is easily understood: “people using technology in transportation to save lives, time and money”.

56. Over a decade of addressing urban traffic issues, intelligent transport systems have been actively adopted by leading countries of the region and have proven their potential as a key enabler of cleaner, safer and more efficient urban transport systems.

57. There is a recent trend to move away from constructing new infrastructure owing to the huge need for capital as well as adverse environmental impacts. Intelligent transport systems can provide cities with a new approach to utilizing existing resources and infrastructure; advanced technologies can help existing infrastructure to operate sustainably at a modest cost which can help reduce the need for new construction.

58. The promotion of intelligent transport systems in the region is in line with General Assembly resolution 72/212 and Commission resolution 73/4 on addressing urban traffic issues.

B. Use of technology to address urban traffic issues

59. Two recent studies on intelligent transport systems indicate that, as of January 2016, 12²⁵ of the 21 member States surveyed have a master plan or national plan relating to intelligent transport systems.²⁶ Advanced traffic management systems are most frequently deployed as a tool to tackle major traffic issues, followed by advanced traveller information systems and advanced public transport systems. Table 2 lists intelligent transport systems in the region and the services offered with them.

²⁴ Johann Andersen and Steve Sutcliffe, “Intelligent transport system (ITS): an overview”, *IFAC Technology Transfer in Developing Countries*, vol. 33, No. 18 (July 2000).

²⁵ Afghanistan; Bangladesh; Cambodia; China; Democratic People’s Republic of Korea; Georgia; India; Indonesia; Iran (Islamic Republic of); Kazakhstan; Lao People’s Democratic Republic; Malaysia; Myanmar; Philippines; Republic of Korea; Russian Federation; Sri Lanka; Turkey; Turkmenistan; Uzbekistan; and Viet Nam.

²⁶ ESCAP, *Development of Model Intelligent Transport Systems Deployments for the Asian Highway Network* (Bangkok, 2017); and ESCAP, *Policy Framework for the Use and Deployment of Intelligent Transport Systems in Asia and the Pacific: Study Report* (Bangkok, 2017).

Table 2
Frequently used intelligent transport systems

<i>Category</i>	<i>Services</i>	<i>Main functions</i>
Advanced traffic management systems	Advanced traffic signal control	Controlling traffic signals to optimize traffic flows
	Automatic traffic enforcement	Monitoring and detecting vehicles infringing regulations (for example, illegal parking, running red lights and speeding)
	Electronic toll collection	Using cashless payments at a toll booth without stopping
Advanced traveller information systems	Mobile/online/roadside (variable message sign) traffic information	Disseminating real-time traffic information, including on crashes, severe weather or road works
	Real-time parking information	Disseminating real-time information about available parking spots and route guidance to those spots
Advanced public transport systems	Automatic fare collection	Allowing users of public transport to pay electronically by smart cards
	Automatic passenger information	Providing real-time passenger information, including on arrival and departure time and location of public transport
	Automatic vehicle location	Determining the geographical location of a vehicle by using global positioning system in real time

Note: For more information, see ESCAP, *Policy Framework for the Use and Deployment of Intelligent Transport Systems in Asia and the Pacific* (Bangkok, 2017).

60. The survey results show that under the advanced traffic management system, traffic signal monitoring and control systems were implemented in 13 countries (62 per cent) and speed violation vehicle enforcement and electronic toll collection systems were implemented in 11 countries (52 per cent). For the advanced traveller information system, basic traffic information with devices were provided in 9 countries (43 per cent) and variable message signs were provided in 13 countries (62 per cent). The bus information system, which is frequently facilitated with automatic fare collection and automatic vehicle location systems, was adopted in 8 countries (38 per cent) as the advanced public transport system.²⁷

²⁷ ESCAP, *Development of Model Intelligent Transport Systems*.

61. Below are some successful examples of the use of intelligent transport systems in urban areas:

(a) In Baku, Azerbaijan, with the adoption of traffic management systems, average travel speed was increased from 8 per cent to 100 per cent on six streets (specifically, Azadliq, Bakixanov, Bulbul, İnsaatçılar, Nobel and Tbilisi);²⁸

(b) In 2010, the Shanghai integrated intelligent transport system was set up in China, which complemented traffic congestion relief efforts by increasing average speed and gridlock-free time by 3 and 7 per cent, respectively, in the central Shanghai urban area;²⁹

(c) The electronic road-pricing system in Singapore controlled traffic demand by charging fees to drivers to maintain target speeds of 45 to 65 kilometres per hour on expressways and 20 to 30 kilometres per hour on arterials;³⁰

(d) Dynamic message signs in the Osaka-Kobe area of Japan reduced travel time by an average of 9.8 minutes per vehicle during congestion periods and up to 38 minutes per vehicle during incident congestion.³¹ The dynamic route guidance systems in the vehicle information and communication system resulted in a 15 per cent reduction in travel time;³²

(e) The use of traffic information and traffic support systems in Indonesia is expected to decrease traffic congestion by approximately 20 per cent;³³

(f) The number of smart card users on public transport continues to increase in the Republic of Korea. As of 2012, 95 per cent of users carried smart cards for their commute.³⁴ After the adoption of the bus information system in 72 cities, bus passengers also significantly increased by 21.4 per cent in 2011.³⁵

²⁸ ESCAP calculations based on data from national intelligent transport system experts from the Baku Transport Agency, Azerbaijan.

²⁹ Xiaojing Wang, “China ITS – Country Study Report”, report prepared for ESCAP, May 2018.

³⁰ United States of America, Department of Transportation, *Reducing Congestion and Funding Transportation Using Road Pricing in Europe and Singapore* (Washington, D.C., 2010).

³¹ Atsush Abe and others, “Evaluation of route comparison information boards on Hanshin Expressway”, paper presented at the Fifth World Congress on Intelligent Transport Systems, Republic of Korea, October 1998.

³² United States of America, Department of Transportation, Benefits Database. Available at <http://www.itscosts.its.dot.gov/ITS/benecost.nsf/ID/F9CBEF32DFA26C20852569610051E2AE?OpenDocument&Query=BAApp> (accessed 28 June 2018).

³³ Omron Social Solutions Co., Ltd. and others, *Study on the Intelligent Transport System (ITS) in Makassar, the Republic of Indonesia – Final Report* (2015).

³⁴ Republic of Korea, Ministry of Land, Infrastructure and Transport, *2013 Modularization of Korea’s Development Experience: Establishment of Intelligent Transport Systems (ITS)* (Seoul, 2014).

³⁵ Kyeong-Pyo Kang, Research Fellow, Korea Transport Institute, “ITS developments in Korea – ITS Master Plan 2020” paper presented at the Asia Leadership Program, Republic of Korea, May 2016.

62. The adoption of intelligent transport systems can positively impact the environment and society in addition to addressing urban traffic issues. Below are some examples of those impacts:

(a) A nationwide electronic toll collection system in China could reduce fuel consumption by 20 per cent on average, carbon dioxide emissions by approximately 50 per cent and carbon monoxide emissions by approximately 70 per cent. Based on the current market price, it could save approximately 150 million Chinese yuan in annual environment pollution control costs.³⁶ In the Republic of Korea, 53 per cent of highway users installed the Hi-pass system as of 2013.³⁷ When a single vehicle run by gasoline used the Hi-pass lane, there was a decrease of 14.8 ml of fuel consumption and 34.6 g of carbon dioxide emissions;³⁸

(b) Intelligent transport systems create new transport industries and job opportunities. Private car-sharing, ride-sharing and web-based taxi businesses in South-East Asia are popular across Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. As of 2015, one web-based taxi business application for smartphones in Asia had been downloaded 4.8 million times and an investment of \$100 million was planned for the next few years.³⁹

C. Urban transport systems in the era of automation

63. Artificial intelligence, the Internet of things and big data analytics can be used as supporting techniques for the automation and maturation of transport systems, and some cities in the region are quickly transforming their traditional use to more automated ones. Even relatively less developed countries are striving to leapfrog the technology gap by absorbing such automation technologies. Cooperative intelligent transport systems, autonomous vehicles and smart mobility are currently the most discussed concepts by member States for future intelligent transport systems.

64. Cooperative intelligent transport systems focus more on the communication among each component of the transport ecosystem: drivers, pedestrians, vehicles and infrastructure. In cooperative intelligent transport systems, all necessary information is shared with these components, eliciting the necessary actions from drivers to avoid potential harm (for example, collisions and incidents) and to avoid anticipated congestion.

65. Some member States have plans to implement cooperative intelligent transport systems as part of their national transport strategies. For example, in China, specific studies on vehicle and road cooperation were conducted from 2011 to 2014.⁴⁰ Two technical standards relating to cooperative intelligent transport systems were already released in 2014, and automobile manufacturers, Internet companies and research institutions are actively

³⁶ “China ITS – Country Study Report.”

³⁷ Kihan Lee, “Korea smart card status and proposal”, presentation made for the IC Card Research and Development Centre, Republic of Korea, April 2013.

³⁸ Republic of Korea, *2013 Modularization of Korea’s Development Experience*.

³⁹ Michael Tegos, “GrabTaxi CEO reveals huge recruitment drive at new \$100M R&D center”, *Tech in Asia*, 8 April 2015.

⁴⁰ Xiaojing Wang, Director, National ITS Center, “ITS update in China”, paper presented at Intelligent Transport Systems Asia-Pacific Workshop, Bangkok, June 2016.

collaborating to promote intelligent driving technology.⁴¹ In the Republic of Korea, the first cooperative intelligent transport systems-related plan was established in 2013.⁴² As of 2014, pilot projects were conducted on urban roads in Daejeon and Sejong, with 90 units of roadside communication and approximately 3,000 on-board devices installed in vehicles, with a budget of \$15 million.⁴³

66. Autonomous vehicles, also called self-driving cars, automated cars or driverless cars, can travel with limited human intervention. One widely accepted definition for autonomous vehicles is: those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration and braking and are designed so that the driver is not expected to constantly monitor the roadway while operating in self-driving mode.⁴⁴

67. An automated driving system was discussed in Japan in 2014 as part of the Cross-ministerial Strategic Innovation Promotion Programme for developing new technologies that avoid crashes and alleviate congestion.⁴⁵ In Singapore, the Land Transport Authority established the first test site for self-driving vehicle technologies and the mobility concept in 2015.⁴⁶

68. The use of smart technologies has led to the smart mobility concept, which is part of smart city initiatives. Smart mobility is an approach to improve urban mobility with different actions, goals and contents enabled by advanced information and communications technology.⁴⁷ Compared to traditional urban mobility,⁴⁸ smart mobility pursues better accessibility when moving people from one location to another by various modes (for example, autonomous vehicles, electric/shared vehicles/bikes, personal rapid transit, to name just a few) in urban areas.

69. A report launched in 2017 included many examples of smart mobility in Asia.⁴⁹ In Singapore, new mobility options, such as personal mobility devices, folding bikes and bike-sharing services, have been embraced in the shift towards more space-efficient modes of transport. In Suwon, Republic of Korea, one community was transformed into an eco-mobility village with a car-free policy. Residents use city-provided shuttle buses, e-bikes and personal

⁴¹ Zhang Jisheng, Chief Engineer, Highway Research Institute, “Current development status and perspectives of ITS in China”, paper presented at a meeting with Ministry of Transport, Beijing, 30 March 2017.

⁴² “ITS developments in Korea – ITS Master Plan 2020.”

⁴³ Republic of Korea, Ministry of Land, Infrastructure and Transport, “C-ITS pilot project planned for Daejeon and Sejong”, press release, 7 August 2014.

⁴⁴ Center for Advanced Automotive Technology, “Connected and automated vehicles” (accessed 25 June 2018).

⁴⁵ Takumi Yamamoto, “Automated driving activities in Japan”, in *Road Vehicle Automation 2*, Gereon Meyer and Sven Beiker, eds. (Cham, Switzerland, Springer, 2015).

⁴⁶ Singapore, Land Transport Authority and Ministry of Transport, “Self-driving vehicles will transform Singapore’s transport landscape”, press release, 12 October 2015.

⁴⁷ Clara Benevolo, Renata Dameri, and Beatrice D’Auria, “Smart mobility in smart city: action taxonomy, ICT intensity and public benefits”, in *Empowering Organizations: Enabling Platforms and Artefacts*, Teresina Torre, Alessio Mario Braccini and Riccardo Spinelli, eds. (Cham, Switzerland, Springer, 2016).

⁴⁸ Ke Fang, “‘Smart mobility’: is it the time to re-think urban mobility?”, *Transport for Development Blog*, 29 April 2015.

⁴⁹ Centre for Liveable Cities and Urban Land Institute, *Urban Mobility: 10 Cities Leading the Way in Asia-Pacific* (Singapore, 2017).

mobility devices instead of using their cars. Suppliers also use electric shuttle services for deliveries from outside the car-free zone.

70. Many developing countries in Asia have initiated smart city plans and strategies with the drive towards smart mobility, including Cambodia, China, India, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, Nepal, the Philippines, Thailand and Viet Nam.

D. Challenges and deployment issues

71. The efforts to address traffic issues with intelligent transport systems in urban areas is not without its challenges and issues relating to the rapid transition caused by adopting emerging technologies.⁵⁰ The cycle of development of new technologies is shorter than that of the governments' supports, in part resulting in belated follow-up in terms of organization and implementation of regulations and policies.

72. Successful implementation of intelligent transport systems requires cross-sectoral and concerted organizational mechanisms encompassing the public and private sectors, as well as harmonization between different stakeholders. For example:

(a) A dynamic environment for intelligent transport system cooperation and collaboration needs to be established by appropriate governments and ministries. However, sometimes each public entity pursues the development of intelligent transport systems without consulting relevant stakeholders. This could create intractable incoherence among organizations enhancing the development of intelligent transport systems in the region;

(b) Long-term national strategies and plans based on the consensus of all stakeholders are the key backbone of effective intelligent transport system utilization. Countries should have an overarching vision, detailed goals and short-, medium- and long-term action plans. Considering that several countries in the region are in the early stages of development of intelligent transport systems, more systematic national strategies and plans are needed;

(c) Intelligent transport system coordination at the regional level from the Asia-Pacific perspective could ensure streamlined services among member States. Many intelligent transport system projects are designed and implemented locally without considering a regional perspective dedicated, inter alia, to consistent system standards and architecture. Regional standards would facilitate efficient interactions among applications and seamless services given that standards contribute to interoperability and compatibility between different systems.⁵¹ Similarly, regional intelligent transport system architecture that defines the functions of the system components would reinforce the holistic approach for rolling out harmonized intelligent transport systems technologies at the regional level.

⁵⁰ Note that the challenges and issues described in this section draw on six country reports from national intelligent transport system experts in Azerbaijan, China, the Russian Federation, Tajikistan, Turkey and Viet Nam and fact-finding missions to China, Malaysia, the Republic of Korea, Singapore and Viet Nam.

⁵¹ European Committee for Electrotechnical Standardization, "The importance of standards" (accessed 25 July 2018).

73. A solid regulatory foundation is a prerequisite to broadly govern the plans, implementation, operations and management of intelligent transport system services with corresponding standards and requirements. Effective policymaking, secure investment and consistency of technology development can be further materialized by detailed regulations. For example:

(a) Only a few member States in the region have established regulations directly relating to intelligent transport systems. However, the terms and descriptions used in such regulations do not necessarily meet the specific system requirements. Updates of existing regulations to accommodate intelligent transport systems are necessary to support faster and more concerted development;

(b) In line with the issues of organizational mechanisms, regulations require various entities' involvement, including not only transport-related agencies but also technology-related agencies. This occasionally leads to disharmonized regulations which could hinder coordinated deployments, installation of compatible systems, justified prioritization of intelligent transport system services, and planned allocation of funds for technology projects;

(c) The latest enhancements in intelligent transport system technologies entail drastic changes to urban transport systems. One recent revolution, as emphasized above, is the new generation of autonomous vehicles. Current regulations do not adequately address emerging autonomous vehicle technologies because of the diversity of autonomous vehicle systems. Considering the large scale of autonomous vehicle penetration in the near future, specific regulatory issues relating to autonomous vehicles need to be understood and discussed among policymakers in the region, including, for example, ways to accommodate autonomous vehicles and traditional vehicles and the aspects to be regulated for autonomous vehicle runs.

74. Many member States have actively pursued intelligent transport system projects which require substantial support for implementation to reach successful outcomes. Some examples are given below:

(a) One common misconception prevalent among policymakers in Asian countries is that the system needs high capital and operational investments, which only developed countries can afford. As proved in North America and Europe,⁵² it is, however, a relatively cost-effective solution to readily tackle urban traffic issues. More favourable policies for its implementation are necessary;

(b) Many developing countries set traditional infrastructure investments (for example, road capacity expansion) as a high priority in addressing urban traffic issues. In comparison, intelligent transport systems are occasionally deprived of priority for government funding. Notably, in some cases, the implementation of approved technology projects is hindered by unstable financial situations. To supplement the public financial shortage and implement them systematically, assessments of various types of innovative financial supports and partnerships, including private financing, need to be encouraged;

(c) A centralized intelligent transport system centre is a building block to exchange integrated traffic information and data in real time. Intelligent transport system services at the national scale will be effectively attained by this centralized system. However, many member States are facing

⁵² Western Michigan University, *Costs and Benefits of MDOT Intelligent Transportation System Deployments* (Kalamazoo, Michigan, 2015).

difficulties in implementing such centralized centres and cooperating and communicating with local centres. Policies to support this centralization are necessary to prevent fragmented and uncoordinated services;

(d) Effective and efficient ongoing operations and maintenance are one major component of intelligent transport system facilities in achieving policy goals. While sufficient numbers of trained professionals and skilled workers are required to maintain a good working condition of facilities, the pool of such experts is limited in some countries of the region.

E. The Commission's activities

75. The secretariat published a study entitled *Policy Framework for the Use and Deployment of Intelligent Transport Systems in Asia and the Pacific* in 2017. This study reviewed selected applications, observed benefits, and possible policy recommendations to be considered for intelligent transport system enhancements in the region. The secretariat also published the *Review of Developments in Transport in Asia and the Pacific 2017*, which provided qualitative comparative analysis by intelligent transport system in one of the chapters.

76. The secretariat is implementing a two-year intelligent transport system project funded by the Korea-ESCAP Cooperation Fund and is planning to organize an expert group meeting and a regional meeting in 2019 to discuss guidelines for regulatory issues for its application.

77. To foster intelligent transport system-related research and knowledge-sharing, the theme of the *Transport and Communications Bulletin for Asia and the Pacific*, No. 88, in December 2018, will be intelligent transport systems.

V. Issues for consideration by the Committee at its fifth session

78. The Committee is invited to consider the issues contained in the present document and to encourage members and associated members to share views, national experiences and practices with respect to improving urban transport systems and services, including the utilization of intelligent transport system technologies. In particular, the Committee may wish to take the following actions:

(a) To consider endorsing the sustainable urban transport index as a tool to measure sustainability of urban transport systems and services in cities and to track improvements over time and progress towards the achievement of Sustainable Development Goal target 11.2;

(b) To encourage members and associate members to use the index in major, secondary and emerging cities of the region;

(c) To encourage member States, cities and related stakeholders to collaborate and work in partnership with the secretariat for wider application of the index and utilize the results to initiate evidence-based policies and measures to improve urban public transport systems and services;

(d) To acknowledge the potential advantages, challenges and issues regarding the development of intelligent transport system and to encourage the use of intelligent transport systems in order to improve the safety, mobility and efficiency of urban transport systems;

(e) To consider supporting the planned activities on developing policy recommendations for intelligent transport systems deployment to overcome the regulatory challenges and issues outlined in the document.
