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Major issues in transport

Developments in transport infrastructure connectivity (2014–2018) in the era of the 2030 Agenda for Sustainable Development

Note by the secretariat

Summary

The 2030 Agenda for Sustainable Development and the Sustainable Development Goals call for ambitious, cross-sectoral and concerted actions at the national, regional and global levels, to ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs (A/42/427). The importance of transport for sustainable development has been extensively discussed and the contribution of the transport sector at large to achieving the Sustainable Development Goals has been broadly acknowledged, both globally and regionally. Notably, member States of the Economic and Social Commission for Asia and the Pacific (ESCAP) endorsed the regional road map for implementing the 2030 Agenda for Sustainable Development in Asia and the Pacific in its resolution 73/9 of 19 May 2017. Importantly, the Ministerial Conference on Transport (Moscow, 2016) identified transport connectivity as the key priority for the ESCAP region to achieve its sustainability objectives and adopted the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017–2021).

Against this background, in the present document, an overview of the status of infrastructure development in the region is provided, the constituent elements of Sustainable Development Goal 9 are defined and the ways in which the pursuit of the Sustainable Development Goals is an integral part of the ESCAP connectivity agenda under the Regional Action Programme are highlighted. Recent developments and potential policy directions are presented through the lens of the comprehensive institutional framework of ESCAP, promoting the development and operationalization of sustainable transport infrastructure through the implementation of the Intergovernmental Agreement on the Asian Highway Network, the Intergovernmental Agreement on the Trans-Asian Railway Network and the Intergovernmental Agreement on Dry Ports.

* ESCAP/CTR/2018/L.1.

I. Introduction

1. As early as 1992, the United Nations Conference on Environment and Development invited the world's Governments to rethink economic development and find ways to halt the destruction of irreplaceable natural resources and pollution of the planet.[1]

2. Twenty years later, noting that progress on action agreed at the Conference had been uneven, the United Nations Conference on Sustainable Development[2] concluded with the adoption of a focused political outcome document entitled "The future we want",[3] indicating clear directions aimed at supporting the attainment of sustainable development. The Conference also decided to launch the process that was to lead to the identification of the Sustainable Development Goals as a way to (a) build upon the success of the Millennium Development Goals,[4] and (b) extend the supporting political will and momentum further over the period 2015–2030.

3. In adopting "The future we want", the international community recognized (a) the importance of the efficient movement of people and goods and access to environmentally sound, safe and affordable transportation as a means to improve social equity, health, resilience of cities, urban-rural linkages and productivity of rural areas, and (b) the need to promote an integrated approach to policymaking at the national, regional and local levels for transport services and systems to promote sustainable development.[5]

4. In September 2015, recognizing that progress towards sustainable development needed further thrust to integrate social, economic and environmental considerations more extensively into policymaking, business practices and lifestyles, the General Assembly adopted resolution 70/1, entitled "Transforming our world: the 2030 Agenda for Sustainable Development", which contains the Sustainable Development Goals. The Agenda and the Goals provide a universal framework for all countries, regardless of their level of development, to realign economic growth with greater social inclusiveness and environmental protection, and seek integrated solutions across a range of issues.

5. The implementation of the 2030 Agenda for Sustainable Development may, however, pose a greater challenge to the transport sector than to any other industry. Indeed, while the transport sector is a key driver of economic development and a provider of employment, it remains a leading contributor to greenhouse gas emissions and a major consumer of fossil fuels. This challenge is even more formidable for the Asia-Pacific region, which enjoys a high birth rate and an expanding middle class with growing affluence and purchasing power that fuel an increased demand for mobility and trade in goods.

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[1] Often referred to as the Rio Conference or the Earth Summit, the Conference took place in Rio de Janeiro, Brazil, from 3 to 14 June 1992.

[2] Often referred to as the Rio+20 Conference, the Conference took place in Rio de Janeiro, Brazil, from 20 to 22 June 2012.

[3] General Assembly resolution 66/288.

[4] The Millennium Development Goals were eight goals and related targets that were adopted by heads of States at the Millennium Summit of the United Nations, held at Headquarters from 6 to 8 September 2000. Scheduled to be implemented during the period 2000–2015, the Goals were aimed at upholding the right of individuals to equality, dignity and access to education, health and freedom from hunger. For further information, see www.un.org/millenniumgoals.

[5] General Assembly resolution 66/288, paras. 132 and 133.

6. Against this background, the Ministerial Conference on Transport (Moscow, December 2016) stressed the key role of transport in implementing the 2030 Agenda and adopted the Ministerial Declaration on Sustainable Transport Connectivity in Asia and the Pacific.[6] The Ministerial Declaration includes the Regional Action Programme for Sustainable Transport Connectivity in Asia and the Pacific, phase I (2017–2021), which in effect localized the implementation of the Sustainable Development Goals in the hands of regional organizations, local institutions and national actors, which are best aware of the socioeconomic characteristics of the region.

7. In the Regional Action Programme, a set of activities are defined that are to be carried out during the period 2017–2021 and provide multiple anchor points for a holistic approach to achieving sustainable transport in the region. These activities give special attention to the need to enhance infrastructure connectivity through continued development, upgrading, planning and operationalization of the transport infrastructure networks of the region, including through the introduction of new technologies and harmonized operational and technical standards.

II. Status of transport infrastructure and services in the region

A. Policy considerations

8. The provision of infrastructure is a critical, albeit not sufficient, condition for accomplishing the objectives of sustainable connectivity. In general terms, the level and performance of connectivity are measured by the ability and ease with which movements can be efficiently organized between a number of points, primarily origins and destinations, but also intermediary points. The more points that can be accessed, the greater the potential number of movements, the more frequent the services to the final destinations in question, and, finally, the higher the level of connectivity. Connectivity is, therefore, the availability and reliability of transport that enables people and goods to reach a range of destinations at reasonable costs and within reasonable time frames.

9. On the premise of the above definition, seamless connectivity necessitates intermodality, an objective that the Economic and Social Commission for Asia and the Pacific (ESCAP) has long been striving for in its activities, thereby preceding and supporting General Assembly resolution 72/212 of 20 December 2017 on strengthening the links between all modes of transport to achieve the Sustainable Development Goals. In the resolution, the General Assembly notes that in developing multimodal transport systems, emphasis should be placed on low-carbon-based and energy-efficient modes of transport and an increased reliance on interconnected transport networks for seamless and “door-to-door” mobility and connectivity of people and goods.

10. Importantly, in moving forward towards enhanced transport connectivity in the region, the Intergovernmental Agreement on the Asian Highway Network,[7] the Intergovernmental Agreement on the Trans-Asian Railway Network[8] and the Intergovernmental Agreement on Dry Ports[9]

[6] E/ESCAP/MCT(3)/11.

[7] United Nations, *Treaty Series*, vol. 2323, No. 41607.

[8] United Nations, *Treaty Series*, vol. 2596, No. 46171.

[9] United Nations, *Treaty Series*, No. 53630.

provide a comprehensive institutional framework within which related policies and actions can be collectively defined and implemented. The three Intergovernmental Agreements were negotiated under the auspices of ESCAP with a view to creating a greater collective convergence of purpose in the realization of multilateral global or regional programmes such as the Sustainable Development Goals or the Regional Action Programme. ESCAP administers these Agreements, convenes the Working Groups established as per the legal requirements of each, and develops tools, projects and guidelines for their implementation.

11. The Asian Highway and Trans-Asian Railway networks comprise 143,000 km of highways in 32 countries[10] and 118,000 km of railway lines in 28 countries.[11] Both networks should conform with the flexibly defined minimum technical specifications and operational standards stipulated in the respective Agreements. In addition, the identification of a set of dry ports of international importance under the recent Intergovernmental Agreement on Dry Ports has facilitated the integration of the two networks with one another as well as with other modes, thereby combining them into the indispensable intermodal infrastructure asset that the region needs as a basis for seamless intermodal connectivity.[12]

12. In the past two decades, countries in the region, with the support and technical assistance of ESCAP, have utilized the Asian Highway and Trans-Asian Railway networks to develop their road and rail infrastructure and, in so doing, have managed at minimal cost to accommodate increasing volumes of international trade on mostly existing infrastructure. This first collective effort has gone a long way towards aggregating disparate infrastructure systems into a common regional network that is best able to serve the region's economic integration, strengthen its future economic growth and facilitate the exchange of goods and services. Yet, the vision of sustainable, integrated and intermodal transport corridors will not be fully realized unless (a) sustainable transport is seen as a priority development issue receiving adequate investment across countries of the region regardless of income groups and geographical characteristics, and (b) related policies are anchored in sound infrastructure planning and investment.

13. In that regard, the effective integration of the Asian Highway and Trans-Asian Railway networks, with connections to inland waterways, seaports, river ports, airports and dry ports, could play a catalytic role in addressing the specific challenges facing landlocked and transit developing countries. Meanwhile, coupled with efficient maritime connections, it could also facilitate the inclusion of archipelagic and Pacific island countries into the region's mainstream economic success. This point was echoed by the General Assembly in its resolution 72/212, in which it stressed the importance of enhancing inter-island connectivity and linking the economies of small island developing States to regional markets and global supply chains, including by integrating them into existing and emerging maritime and multimodal transport and economic corridors.

[10] For a map of the Asian Highway network, see www.unescap.org/sites/default/files/AH-map_2018-2.pdf.

[11] For a map of the Trans-Asian Railway network, see www.unescap.org/sites/default/files/TAR%20map_1Nov2016.pdf.

[12] For extensive information on the background and status of the Intergovernmental Agreement on Dry Ports, see document ESCAP/CTR/2018/4.

14. Yet, port infrastructure is too often designed and developed with the sole idea of accommodating maritime vessels. As gateways to land transport networks, ports should also be developed as an essential component of any policy that aims to enhance access to hinterland areas through intermodal corridors. It follows that greater policy coordination between responsible agencies should lead to increased attention in future port design to interfaces with land transport modes, in particular railways.

15. At the moment, very few, if any, ports in the region have a layout that is compatible with the efficient operation of trains, in particular container trains. In this respect, two major impediments need to be addressed: (a) rail loading and unloading tracks must be of sufficient length to accommodate full-length trains; and (b) they must be located close to berth-side container stacks to allow single-lift loading and unloading operations using port handling equipment, such as portal cranes or reach stackers. In their current design, most ports, far from encouraging a modal shift from road to rail, actually reinforce the predominant use of road transport for inbound and outbound movements. This feature delays the emergence of fuel-efficient, environmentally friendly and cost-effective transport systems in support of the 2030 Agenda.

16. The Trans-Asian Railway network could play a pivotal role in addressing a modal shift. Yet a total of 11,500 km, or 9.8 per cent, of the 118,000-km network is still missing. The total investment required to put in place these missing cross-border rail links is estimated at $75.5 billion.[13] Furthermore, differences in the technical reliability of the rolling stock, limited interoperability and break of gauge lead to trans-shipment costs and delays as well as load capacity issues. While roads can be built and upgraded in stages, as demand or financing increases, rail systems require strong upfront government commitment and funding.

17. With this in mind, ESCAP is actively engaging with its members in identifying areas for joint and coordinated action aimed at addressing infrastructure requirements, capacity bottlenecks and institutional issues that still prevent wider use of rail transport for international movements.

18. There is growing acceptance among policymakers in the region that rail has an important role to play in the era of the 2030 Agenda. Indeed, a number of factors speak in favour of greater utilization of rail transport in Asia, namely: (a) the fact that 12 of the world's landlocked countries are located on the Asian continent, with the nearest ports often several thousands of kilometres away; (b) the fact that the distances linking the main origins and destinations, both domestically and internationally, are of a scale on which railways find their full economic justification; (c) the continuing surge in the volumes of goods being exchanged; and (d) the recognition of rail as an environmentally friendly and safe mode of transport.

19. Taking note of the above, ESCAP implemented, in 2017, a project entitled "Development of seamless rail-based intermodal transport services in North-East and Central Asia for enhancing Euro-Asian transport linkages", with the active participation of transport officials and railway managers from China, Kazakhstan, Mongolia, the Republic of Korea and the Russian Federation. Under the project, ESCAP conducted two studies which identified best practices and recommendations on (a) the simplification of documentation, and (b) the deployment and use of information technology in promoting greater efficiency of rail-based intermodal transport services.

[13] ESCAP estimate.

20. Regarding the Asian Highway Network, to date, 7 per cent of its routes still do not meet the minimum desirable class-III standards. In addition, while member countries have made undeniable progress in upgrading Asian Highway routes through their territories, the network still presents too many instances of a same route falling into different categories of standards on two sides of a common border between neighbouring countries. This hampers the development of international cross-border road movements, as road operators perceive poor infrastructure as posing a risk of injury to drivers and damage to vehicles.

21. Notwithstanding the above, the Asian Highway network has reached a level of maturity today that was inconceivable in the early days of its conception. Mindful of the fact that quality infrastructure should also address safety considerations, in December 2017 the parties to the Intergovernmental Agreement on the Asian Highway Network adopted a new annex to the Agreement, on design standards for improving road safety along the Asian Highway network. The new annex provides a coordinated approach to the development and adoption of standards for road infrastructure safety facilities and is set to enter into force 12 months after two thirds of the parties submit their instrument of acceptance to the depositary, as stipulated in article 8 (5) of the Agreement.[14]

B. Improving infrastructure connectivity in the region: selected multilateral initiatives

22. The Asian Highway and Trans-Asian Railway routes have consistently supported the definition of several multilateral transport initiatives, such as the Central Asia Regional Economic Cooperation programme of the Asian Development Bank (ADB) and the Singapore-Kunming Rail Link project of the Association of Southeast Asian Nations (ASEAN). Notably, the Asian Highway network has also contributed to the negotiation of two important agreements: (a) the agreement between the Governments of member States of the Shanghai Cooperation Organization on creating favourable conditions for international road transport, signed in Dushanbe in September 2014; and (b) the Intergovernmental Agreement on International Road Transport along the Asian Highway Network, signed by the Governments of China, Mongolia and the Russian Federation in Moscow in December 2016.[15] Both agreements were negotiated with ESCAP technical assistance and the secretariat continues to provide assistance to member States concerned in their implementation.

23. Asian Highway and Trans-Asian Railway routes continue to provide a backdrop for the promotion of subregional economic synergies through multilateral programmes touching upon infrastructure development, modal integration and cross-border initiatives. In its 2014 *India Transport Report*, the Government of India stated clearly that to achieve a significant improvement in productivity and efficiency, it was imperative that the future planning of the Indian transport network should be aimed at the development of multimodal transport, both within the country and for export-import trade.[16]

24. Acting on the above, the Government of India has collaborated with its neighbours on implementing several projects within such frameworks as the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic

[14] For more detailed information and a model instrument of acceptance, see document ESCAP/CTR/2018/7.

[15] For more information on developments in the field of facilitation of operational connectivity, see document ESCAP/CTR/2018/2.

[16] India, *India Transport Report: Moving India to 2032* (New Delhi, 2014).

Cooperation, the Bangladesh-Bhutan-India-Nepal initiative and the South Asia Subregional Economic Cooperation programme of ADB. These programmes help forge the common political will and address the investment requirement necessary to operationalize the Asian Highway and Trans-Asian Railway networks. For example, under its South Asia Subregional Economic Cooperation programme, ADB is providing funding to Bangladesh to upgrade the 190-km Elenga-Hatikamrul-Rangpur road (which is part of Asian Highway route AH2) and 70-km Joydebpur-Elenga road (which is part of Asian Highway route AH41) to a four-lane highway to improve connectivity among South Asian countries and provide landlocked Bhutan and Nepal with improved road access to the port of Chittagong on the Bay of Bengal.

25. The above efforts could eventually fall into a more ambitious plan aiming at establishing connectivity between South and South-East Asia. The first step in the scheme is the realization of the 1,300-km trilateral highway that would travel from Moreh in the north-eastern state of Manipur in India to Mandalay and Nay Pyi Taw in Myanmar, and finally across the border to Mae Sot in the north-western Tak province of Thailand. The planned four-lane highway is also part of the proposed ASEAN east-west corridor and of Asian Highway routes AH1 and AH2. From Mae Sot, the highway could continue through Thailand to Cambodia, the Lao People's Democratic Republic and Viet Nam to the west, and Malaysia and Singapore to the south.

26. As regards rail connectivity, in 2017, Azerbaijan, Georgia and Turkey completed the Baku-Tbilisi-Kars rail project, including construction of the 98-km missing link in the Trans-Asian Railway network between Akhalkalaki, Georgia, and Kars, Turkey. Once the Qazvin-Rasht-Astara missing link between the Islamic Republic of Iran and Azerbaijan has been completed, the Baku-Tbilisi-Kars rail project will offer further transit potential to Central and Southern Europe for Afghanistan as well as for the landlocked countries of Central Asia.

27. Whether as part of the Trans-Asian Railway network or outside the framework that it provides, Governments in Central Asia are implementing or considering a number of rail infrastructure projects to enhance their connectivity with neighbouring subregions and gain access to international ports in China (such as Shanghai, Lianyungang and Tianjin) and the Islamic Republic of Iran (such as Bandar Abbas and Chabahar; see paragraphs 28 and 29). Of particular importance to this concept are the missing link in the Trans-Asian Railway network between China, Kyrgyzstan and Tajikistan, and the proposed rail infrastructure that the Government of Afghanistan plans to develop, in particular the 1,300-km east-west line in the northern part of the country from Nizhniy Pyandzh at the border with Tajikistan to Shamtigh at the border with the Islamic Republic of Iran. This line will be connected to branches coming off Uzbekistan such as the existing 75-km section between Termez, Uzbekistan, and Mazar-i-Sharif, Afghanistan, or off Turkmenistan such as the existing 88-km section between Atamyrat, Turkmenistan, and Aqina, Afghanistan, or the planned section through the Torghundi border point. In September 2018, ESCAP conducted a capacity-building seminar for all the countries concerned with the objective of addressing rail connectivity gaps and identifying concrete steps forward.

28. The Iranian port of Chabahar holds special significance in the nascent architecture of connectivity between Central Asia, Europe and South Asia. The first phase of construction was completed in December 2017, with further stages of development due to be implemented in the future. Development plans include a possible rail link through Zahedan to connect with the Bafq-Mashhad-Sarakhs trunk line, offering rail connectivity to Afghanistan via the

new line being considered in northern Afghanistan (see paragraph 27) and to Central Asia via the existing line linking the Islamic Republic of Iran and Turkmenistan at Sarakhs from where rail connections already exist to other countries of Central Asia.

29. The Chabahar port project was financed by India as part of a 2016 trilateral agreement between Afghanistan, India and the Islamic Republic of Iran to develop a transport and trade corridor from India to Afghanistan using Chabahar port as one of the regional hubs for maritime transport. Enhanced maritime connections between Jawaharlal Nehru port, east of Mumbai, and Chabahar would considerably enhance trade between Central Asia and South Asia, in particular Bangladesh, India and Nepal. Within the context of the recently commissioned Baku-Tbilisi-Kars corridor (paragraph 26), the Chabahar project gives further uplift to the Qazvin-Rasht-Astara project and the development of the Western Dedicated Freight Corridor under construction by Indian Railways to connect Mumbai to Tughlakabad, the largest dry port in India south-east of New Delhi. The recent launch of new bilateral rail services between Bangladesh and India,[17] and the planned construction of a rail section from Agartala, India, to Akhaura, Bangladesh, could further complement these projects and give reality to a land-cum-sea corridor extending from the north-eastern states of India to Istanbul with multiple connections to other subregions in both Asia and Europe.

30. It is worth noting that the trend for larger vessels, especially container ships, is spurring additional port investment in the region, such as the extension of berth length, dredging to provide deeper draught and procurement of modern cargo-handling equipment. One such example is the Anaklia deep seaport project in Georgia, which will be 16 metres deep and handle multiple cargo and vessel types, with capacities of up to 10,000 twenty-foot-equivalent-unit containers. Set to open in 2021, this $2.5-billion project will be constructed in nine phases. The first phase of the project was launched in late 2017 and includes the construction of a container terminal with a capacity of 900,000 twenty-foot-equivalent-unit containers and a dry bulk cargo facility with a capacity of 1.5 million tons. Planned in conjunction with the development of a special economic zone, the port is being developed as a transit point between Europe, the Caucasus region and Central Asia, including the Islamic Republic of Iran.

31. The above shows that corridors provide a blueprint for enhanced connectivity, increased competitiveness and a greater sense of community in the region. In that spirit, cross-sectoral, multi-country initiatives such as the Belt and Road Initiative can also serve to further strengthen the ESCAP integration mechanisms and encourage the joint planning of projects based on a shared vision of development. This is of particular importance when it comes to rail transport development in the region, as rail can offer safe, reliable and energy-efficient transport across vast distances. In that respect, construction began in June 2017 of a 420-km single-track line connecting China, the Lao People's Democratic Republic and Thailand, at high cost and presenting engineering challenges. At both ends, this new line will connect with existing Trans-Asian Railway network sections that are being upgraded in China and Thailand to create transport infrastructure that is able to serve the expected rise in trade between China and the ASEAN Economic Community. When completed, the line will be part of economic corridors connecting industrial zones in the south-east of Thailand, as well as offering a trade conduit to the Dawei industrial complex being considered by the Government of Myanmar.

[17] "Connectivity projects boost India-Bangladesh ties", *Times of India*, 10 November 2017.

32. Pending the costly establishment or upgrade of cross-border land transport infrastructure, member States have also started to develop maritime connectivity between their respective ports for onward connection to their national road and rail network. Thus, in November 2017, the Governments of Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand started discussing a Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation coastal shipping agreement to enhance trade between those countries. The agreement would apply to shipping within 20 nautical miles of the coastline, for which ship movements require smaller vessels and less draught, and therefore involve lower costs. Starting with a connection between Ranong province in Thailand and Chittagong port in Bangladesh, the network would then be expanded to the ports of Kolkata, Chennai and Visakhapatnam in India and Hambantota in Sri Lanka.[18]

33. Under the Regional Action Programme, the activities of ESCAP with respect to developing the Asian Highway and the Trans-Asian Railway networks, as well as the regional network of dry ports of international importance, continue to be tools that policymakers can use to benchmark trends, define a common vision of infrastructure development, adopt joint programmes of action and create partnerships for regional economic integration and sustainable connectivity. At the same time, by developing synergies between programmes, activities and initiatives, the efforts of each country, organization or agency remain focused and the use of resources is optimized.

III. Transport infrastructure connectivity and the Sustainable Development Goals

A. Building resilient infrastructure

34. The relevance of well-connected transport infrastructure for trade and economic development has never come into question, as evidenced by relentless efforts by countries and intergovernmental institutions to address the infrastructure gap to meet the growing demand for transport and mobility. As at 2017, ADB estimated that meeting infrastructure needs in Asia and the Pacific – including transport, energy and telecommunications infrastructure – would require $22.6 trillion in investment over the period 2016 to 2030.[19]

35. However, it is only in recent years, notably with the introduction of the sustainability concepts in relation to transport, that infrastructure has received renewed attention. Sustainable Development Goal target 9.1 is aimed at developing quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all. In turn, this raises new questions on the approach to infrastructure planning and investment, to take account of what it means to have sustainable and resilient infrastructure and the kinds of policy decisions that are needed to accomplish it.

36. There is no commonly agreed definition of the term “quality infrastructure”. In principle, transport infrastructure that is soundly built, that can be safely used and operated and that is adequately maintained throughout its life cycle could be considered to be of good quality. However, it should be noted that the quality of infrastructure can only be measured in relative terms, since quality depends on factors such as land, labour, technical expertise and

[18] “Bimstec talks highlight cooperation”, *Bangkok Post*, 1 September 2018.

[19] ADB, *Meeting Asia’s Infrastructure Needs* (Manila, 2017).

capital. It follows that as economies grow and more resources become available, efforts are made to continually improve the quality of infrastructure. In that regard, the relevance of technology for improving the safety performance of transport infrastructure cannot be overemphasized.

37. The term "reliability" is generally used to express a degree of assurance that a component or system will operate successfully or at least at a desired level of performance in a specified condition during a certain period of time.[20] From the transport perspective, infrastructure is expected to be technically reliable and able to meet the demand for mobility at all times and in all (or most) weather or other external conditions. However, the failure of part of a road, rail or other network does not necessarily imply instability or unreliable conditions, as long as modes are integrated and alternatives are readily available. In short, reliable transport infrastructure ensures efficiency of and accessibility to transport, both of which are objectives of sustainable transport.

38. The term "sustainable infrastructure" is often used with reference to the process of designing, building and operating structural elements in ways that do not diminish the social, economic and ecological processes required to maintain human equity, diversity and the functionality of natural systems. Building new infrastructure or upgrading existing infrastructure is expensive, requires the use of carbon-intensive materials and has other environmental disadvantages.

39. However, the infrastructure itself is typically accountable for only a small percentage of total greenhouse gas emissions. The contribution from infrastructure to environmental sustainability would therefore be to minimize the emissions embedded in construction and arising from maintenance. In addition, more seamless operation of transport across modes will mean that growing demand can be accommodated on proportionately less infrastructure, with materially better service to users and significant energy savings. It follows that, within the scope of Sustainable Development Goal target 9.1, sustainable transport infrastructure can be understood as ecologically sound, climate-neutral and energy efficient infrastructure.

40. The term "resilience" is perhaps the most complex to define and one which is most commonly associated with disaster risk reduction strategies. The concept was first introduced in ecology in the 1970s as a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.[21] In the transport context, resilience entails ensuring transport system integrity, service reliability and functionality, as well as rapid recovery after acute shock or chronic stresses,[22] such as may be caused by natural or climate-change-related disasters, cyberattacks or ageing infrastructure.

41. The engineering sector refers to this scenario as the fail-safe design, whereby relying on one transport mode increases risks, whereas ensuring the modal integration and optimization of all modes in their respective areas of strength can increase the amount of change that a system can undergo before it crosses a threshold and flips to an alternate – and suboptimal – stability

[20] Shelemyahu Zacks, *Introduction to Reliability Analysis: Probability Models and Statistical Models* (New York, Springer-Verlag, 1992).

[21] C.S. Holling, "Resilience and stability of ecological systems", *Annual Review of Ecology and Systematics*, vol. 4 (1973).

[22] Judith Y.T. Wang, "'Resilience thinking' in transport planning", *Civil Engineering and Environmental Systems*, vol. 32, No. 1-2 (2015).

regime.[23] This circles back to the importance assigned by ESCAP member States to sustainable and intermodal connectivity as defined in the Regional Action Programme.

42. It follows that the ESCAP institutional architecture on transport infrastructure goes a long way towards meeting the objective of Sustainable Development Goal 9 on infrastructure that (a) is soundly built and can be safely used (quality) and (b) is capable of consistently meeting the demand for transport (reliable).

43. In this connection, the vision of integrated and sustainable transport as embodied in the connectivity agenda of the Regional Action Programme can be realized fully only if the Intergovernmental Agreement on the Asian Highway Network, the Intergovernmental Agreement on the Trans-Asian Railway Network and the Intergovernmental Agreement on Dry Ports are used as a comprehensive institutional framework to trigger concerted action at the regional level. This would increase the capacity of the networks to function as an integrated system in emergency situations, by ensuring that alternative routes and access points are available and thereby reducing the risks of disproportionate reliance on one transport mode (resilience). As such, accession to the Agreements by those countries that have not yet done so, and a coordinated approach to the designation of road and rail routes and dry ports, would be a key enabler for achieving the objectives of the Regional Action Programme.

B. Enabling transformative technology and innovation

44. In its above-mentioned resolution 72/212, the General Assembly also stressed the necessity of promoting the integration of science, technology and innovation into sustainable, integrated, multimodal and intermodal transport systems by tapping into technological opportunities in the decades to come to bring about fundamental, transformative changes to transport systems.

45. Traditionally, infrastructure projects have been seen as predictable, engineering-driven and labour-intensive, and not at the cutting edge of technology. Yet a wide array of breakthrough technologies are rapidly transforming the way in which infrastructure is built and operated and reshaping the way in which the infrastructure industry itself operates. The fast-expanding network of digitally-connected objects – devices, vehicles and more – that are embedded with sensors and intelligent computing capabilities, known as the Internet of things, opens up new opportunities in meeting the reliability and resilience side of infrastructure described above. These technologies allow not only better structural design in the circumstances prevailing at the time of construction but also better monitoring of specific infrastructure assets as these circumstances evolve, thereby guaranteeing access to safer infrastructure. For example, 50 years on, the monitoring of the real-life conditions of the bridge that recently collapsed in Italy would have allowed regular matching of the bridge construction standards in the context of increasing traffic, heavier vehicle-loads and more intense battering by natural elements resulting from climate change, and palliative measures could have been taken to avoid disaster.

46. In recent years, technology – in particular information and communications technology – has profoundly changed the ways in which transport operates and has had a transformative impact on the expectations of

[23] Ibid.

services by industry and people. The speed and ease with which data can be collected, transmitted and processed have changed the way in which infrastructure and vehicles are designed, operated and maintained.

47. There is ample scope to further explore and promote the deployment of these cutting-edge technologies and innovations as part of the region's push to achieve the Sustainable Development Goals, as briefly outlined below.

Transport-related activities in relation to selected Sustainable Development Goals

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

Target 4.4. By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

Process. The adoption of new digital technologies can lead to new business models assisting member States in raising the attractiveness of employment in the transport sector for youth and bring into the logistics and transport sector a new generation of skilled workers.

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all.

Target 7.3. By 2030, double the global rate of improvement in energy efficiency.

Process. New technology has been devised using which the energy released during the braking of trains is looped back into the overhead lines which are connected to bus stops in front of the train station (see also Sustainable Development Goal target 11.6. below).

Goal 3. Ensure healthy lives and promote well-being for all at all ages.

Target 3.9. By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable.

Target 11.6. By 2030, reduce the adverse per capita environmental impact of cities, including by paying attention to air quality and municipal and other waste management.

Process. The technology described in Sustainable Development Goal target 7.3 stores the released electricity for use by electric buses, thereby contributing to more sustainable forms of urban transport.

Goal 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Target 9.1. Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Process. New and highly sensitive sensors, which measure changes in electrical resistance, can be embedded in the concrete of a bridge to monitor the stresses on it. The sensors not only provide data wirelessly to traffic managers on the bridge's load-bearing capacity, but also provide engineers with a stream of real-time data about the health of its structure. In the event

of an earthquake, for instance, the sensors can assess the bridge's dynamic performance, and help determine its residual capacity.

The use of unmanned aerial vehicles (drones) can also provide sustainable, low-cost and impartial supervision over investment sites, as well as fully operational infrastructure.[a] Drones' fast and accurate data acquisition, along with advanced three-dimensional modelling tools, can facilitate design processes through the provision of precise geospatial data, but also help to limit the costs of adjusting plans and designs.

Drones equipped with high-resolution cameras and scanners can replace humans in conducting precise inspections. Advances in image-processing offer precision that is unattainable by the human eye. This is most important when access to infrastructure is difficult or poses a risk to inspection crews. Additionally, data presented in the form of a heat map is easy to interpret and helps with the precise planning of repairs.

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Target 15.2. By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally.

Process. A hybrid plastic sleeper is gradually being introduced on some railways. This sleeper is made of recyclable plastic and reinforced with two steel bars using a patented production process to achieve the required rigidity and strength. The sleeper has a lifespan of more than 50 years, compared to just 10 years for untreated oak sleepers, while offering the same level of damping and continuous track stiffness. The sleeper was developed in response to the European ban on the use of creosote in railway sleepers and the restricted availability of hardwood.

[a] For a detailed overview of the use of drones in transport, see PwC, "Clarity from above: transport infrastructure – the commercial applications of drone technology in the road and rail sectors", January 2017.

48. Given that the design and industrial development cycle of innovative technologies has, in many instances, become shorter than the policy cycle, planning and regulatory authorities often experience a time gap between the arrival of new technologies and their actual commissioning at the national level. Against that background, ESCAP members can leverage the secretariat's intergovernmental platform to receive and exchange information on best practices in the use of technology for transport infrastructure, thus not only enabling a faster national policy cycle that is responsive to new developments, but also better aligning infrastructure development in the region with the objectives of the Sustainable Development Goals. The Working Group on the Asian Highway and the Working Group on the Trans-Asian Railway Network are two ideal platforms to discuss and promote related actions or initiatives through a review of best practices and a sharing of know-how.

IV. Considerations by the Committee

49. The Committee is invited to consider the present document and provide information on ongoing or planned projects aimed at realizing greater subregional and regional connectivity.

50. The Committee is further invited to share views, national experiences and practices on achieving reliable, sustainable and resilient infrastructure. In particular, the Committee may wish:

(a) To provide guidance on ways to further strengthen ESCAP activities and partnerships in support of regional transport infrastructure connectivity, in keeping with the objectives of the Regional Action Programme;

(b) To encourage member States that have not already done so to accede to the Intergovernmental Agreement on the Asian Highway Network, the Intergovernmental Agreement on the Trans-Asian Railway Network and the Intergovernmental Agreement on Dry Ports, in the interests of modal integration and sustainable connectivity;

(c) To encourage the use of the ESCAP intergovernmental platform to receive and exchange information on best practices in the use of technology for transport infrastructure construction, monitoring, maintenance and operation;

(d) To invite the secretariat to seek partnerships with leading research institutes in the region to disseminate knowledge on technological trends related to infrastructure resilience, promote the use of technology and innovation, and identify relevant activities in cooperation with member States.