UNITED NATIONS
ESCAP
Economic and Social Commission for Asia and the Pacific

73rd COMMISSION SESSION
Regional cooperation for sustainable energy

ASIA-PACIFIC COUNTRIES WITH SPECIAL NEEDS DEVELOPMENT REPORT 2017

Investing in infrastructure for an inclusive and sustainable future

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Investing in infrastructure for an inclusive and sustainable future

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United Nations publication
Sales No. E.17.II.F.9

Printed in Bangkok
ISBN: 978-92-1-120743-9
e-ISBN: 978-92-1-060456-7
ISSN: 2520-6435
ST/ESCAP/2774

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FOREWORD

Thirty-six economies in the Asia-Pacific region are least developed countries, landlocked developing countries or small island developing States. Collectively referred to as "countries with special needs" (CSN), these are the most vulnerable countries in the region. For example, lack of direct territorial access to the sea translates into remoteness and isolation from world markets for landlocked developing countries. Geographic isolation and lack of economies of scale poses a particular development challenge to small island developing States, where climate change threatens their existence. Among the plethora of development challenges of least developed countries, the lack of productive capacities stands out. Addressing such development challenges is critical for these countries' future and for their effective pursuit of the 2030 Agenda for Sustainable Development.

The 2017 edition of the *Countries with Special Needs Development Report* highlights the importance of infrastructure in achieving inclusive growth and sustainable development, and analyses the scale of infrastructure deficits and associated financing requirements in these countries. As infrastructure provides wide economic, social and environmental benefits, it constitutes an essential part of the United Nations 2030 Agenda for Sustainable Development and has been accorded a high priority among the goals and actions agreed upon in the global programmes of action for these countries; these actions include the Istanbul Programme of Action for least developed countries, the Vienna Programme of Action for landlocked developing countries, and the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway.

Recognizing that the availability, quality and type of physical infrastructure vary significantly among the CSN, this report introduces an *Access to Physical Infrastructure Index*. This index is used to analyse the multidimensional character of infrastructure as well as illustrate the strong positive relation between infrastructure and the economic, social and environmental pillars of sustainable development in these countries.

Despite significant differences in economic conditions, geographic characteristics, demographic features and institutional capacities, the index demonstrates that the CSN have significant deficits in common in physical infrastructure. The average index for CSN is a third lower than for other developing countries in the region and less than half that of developed countries in the region. These deficits pose a principle obstacle to the sustainable development of CSN as they limit the opportunities to expand productive capacities and improve connectivity across and between countries. Infrastructure deficits also constrain social development and weaken environmental sustainability.

As we enter the second year of the 2030 Agenda, it is critical that a higher policy focus in the CSN is placed on improving availability and access to sustainable infrastructure. Doing so will enable the CSN to better harness their development potential and lay a solid foundation for the attainment of the 2030 Agenda.

With its theme of 'Investing in infrastructure for an inclusive and sustainable future', this report highlights the fact that CSN will need to invest, on average, an amount equivalent to 10.5 per cent of their GDP every year in order to close the infrastructure deficit, taking population growth, increasing urbanization and the impact of climate change into account. This far exceeds current levels of infrastructure funding in these economies, which ranges between 4 per cent and 7.5 per cent of GDP. It is therefore paramount that policymakers prioritize investment in infrastructure and sequence investment to make the most effective use of available resources.

Given the limited public financing resources of several CSN, there is a clear potential for the private sector to play a greater role in infrastructure development. Nevertheless, owing to high up-front capital costs, long gestation periods, large externalities and a significant sensitivity to country risks, infrastructure investment requires significant public policy intervention in order to secure non-public funding. In this regard, in many CSN, greater capacities in the public sector will be needed to foster effective public-private partnerships. Yet, in most countries, the role of private sector participation in infrastructure development is likely to remain limited, due to small domestic markets, a lack of economies of scale and developed capital markets, or exogenous factors such as geographic location or size of population. Greater assistance from the international community will therefore remain paramount for many CSN in their endeavour to develop sustainable infrastructure.

Policymakers in the region will find this report useful when designing and adapting national development policies to support sustainable development, just as development partners can use it to re-align their cooperation strategies with the priorities of CSN.

As always, ESCAP stands ready to continue partnership with the private sector, Governments and development partners in strengthening the joint response to meeting the challenges of sustainable infrastructure, particular in the most vulnerable of countries in the region, i.e., the CSN. Concerted efforts of all the stakeholders – public, private and international – are crucial to bringing about the necessary positive change and accelerating multimodal infrastructure development in the region's least developed countries, landlocked developing countries and small island developing States.

Shamshad Akhtar
Under-Secretary-General of the United Nations and
Executive Secretary, United Nations Economic and
Social Commission for Asia and the Pacific

EXECUTIVE SUMMARY

Infrastructure provides wide economic, social and environmental benefits. It enables the provision of services to people, and empowers and connects them to each other and to markets and opportunities. Infrastructure improvement is therefore critical to development, particularly for least developed countries, landlocked developing countries and small island developing States, which comprise the group of countries with special needs. Indeed, infrastructure is included as a goal in the 2030 Agenda for Sustainable Development (Goal 9). In the Addis Ababa Action Agenda, member States agreed to establish the Global Infrastructure Forum; it is also given a high priority in the Istanbul Programme of Action for least developed countries, the Vienna Programme of Action for landlocked developing countries and the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway.

This report focuses on four sectors of physical infrastructure that are particularly important to development: transport; energy; information and communications technology (ICT) and water supply and sanitation, as infrastructure development in these sectors has direct implications for economic activities, social development and environmental sustainability in the following ways:

(a) Sustainable transport systems play a critical role in development by (i) providing access to economic and social opportunities, (ii) facilitating the movement of people, goods, labour, resources, products and innovations, (iii) creating market opportunities, (iv) enabling manufacturers to take advantage of locational strengths and (v) allowing the expansion of supply chains across borders. Transport infrastructure is a prerequisite for economic growth;

(b) The availability of energy is also a prerequisite for economic growth. Energy services also contribute to social development by, for example, improving education and health outcomes, and contributing to environmental sustainability by providing access to clean fuel for cooking and heating;

(c) Water supply and sanitation infrastructure is crucial to improving social well-being, as a lack of access to water supply and sanitation leads to economic loss and health problems. Access to clean water supply has an impact on economic growth by freeing resources that are otherwise spent on health care, and it is an important determinant of environmental sustainability;

(d) The spread of ICT has great potential for accelerating human progress by bridging the digital divide and developing knowledge societies. ICT is a key to accelerating achievement of the sustainable development goals.

ESCAP Access to Physical Infrastructure Index

The availability, quality and type of physical infrastructure vary significantly among the countries with special needs. This is mostly due to different economic conditions, geographic characteristics, demographic features and institutional capacities. Nevertheless, countries with special needs have large infrastructure deficits due to inadequate development and poor maintenance of their existing infrastructure.

To quantitatively assess and compare physical infrastructure in countries with special needs, this report presents the Access to Physical Infrastructure Index. This index provides a quantitative assessment of physical infrastructure by capturing two indicators each of transport, energy, ICT, and water and sanitation-related infrastructure, and calculating a composite index that comprises all eight indicators. The index highlights the performance of countries with special needs in infrastructure compared to each other and over time, and can be used as a tool for development policies in support of sustainable development. The index, which has been computed for 41 countries in the Asia-Pacific region – of which 23 are countries with special needs, 15 are other

developing countries in the region and three are the developed countries in the region – reveals that three countries with special needs are ranked among the 10 countries with the best access to infrastructure in the region. All countries with least access to infrastructure are countries with special needs, seven of which are least developed countries.

Financing infrastructure development

Closing infrastructure gaps will require significant financial resources. ESCAP estimates that the total financing needs for closing existing gaps, keeping up with growing demands for new infrastructure, maintaining existing infrastructure and taking into account the impacts of climate change, are close to 10.5 per cent of GDP per annum on average in countries with special needs. Without climate change mitigation and adaptation costs, 8.3 per cent of GDP per annum will be needed. This far exceeds current levels of infrastructure funding, with financing needs of least developed countries being the largest, while those of landlocked developing countries and small island developing States are also sizeable.

There are a number of financing opportunities that countries with special needs can tap in order to close the infrastructure gap. These include the domestic public sector, ODA from development partners and multilateral development banks, the private sector, new regional initiatives and infrastructure funds as well as new financing vehicles. However, the extent to which these are viable options varies across countries with special needs and across sectors.

For example, private investment has been more prevalent in energy and ICT infrastructure, enabled in part by the potential of these sectors to generate revenue. Yet, in many countries with special needs the potential for private financing, both domestic and international, remains limited due to risks associated with politics, currency fluctuations and other macroeconomic instabilities, underdeveloped domestic capital markets, lack of access to international capital markets or simply a lack of economies of scale.

Similarly, while external resources, such as ODA and financing through multilateral development banks, play an important role in infrastructure financing, they constitute only a small proportion of total infrastructure spending, and may be limited in areas of cooperation, instruments of financing as well as dependent on the preferences and capacities of donors. Nevertheless, these sources are especially important in economies with small populations and in the least developed economies of the region, where private sector participation in infrastructure financing is likely to be limited given the lack of capital markets and absence of economies of scale.

In other economies, new sources of long-term finance will need to be tapped, including from institutional investors, through new global and regional initiatives including climate financing, or supported by the development of capital markets.

Priorities

To fill funding gaps and overcome investment challenges, Governments of countries with special needs must identify clear financing strategies and capacity development for effective long-term planning, through modalities such as improving public expenditure, mobilizing domestic resources, leveraging the private sector, improving access to capital markets and tapping new sources of funds such as climate finance. Given limited resources, Governments in countries with special needs will also have to prioritize which sectors to develop. This may be based upon where infrastructure gaps are greatest, or where the impact of additional infrastructure on sustainable development outcomes may be the largest.

For example, the Access to Physical Infrastructure Index suggests that providing transport infrastructure and energy is particularly important to the least developed economies. More sustainable, inclusive and reliable energy (especially solar and hydropower) would enable these economies to accelerate the process of expanding their productive capacities and increasing levels of productivity, while bridging transport infrastructure gaps would be important to improving access to domestic and international markets. This could translate into higher wages and contribute to reducing poverty.

The Access to Physical Infrastructure Index points to the need to strengthen ICT infrastructure in small island developing States. Given the potential to engage the private sector in the process, and considering the potential of ICT for expanding the services sector in these economies, public funds can then be used for developing

infrastructure with high environmental or social returns. This is particularly important for water supply and sanitation infrastructure, which is particularly lacking in those economies that are also least developed economies.

For landlocked developing countries, the Access to Physical Infrastructure Index points to the need to improve transport infrastructure. Doing so is important to connecting missing links with neighbouring countries and reducing trade costs. Additional revenue from higher export earnings could, in turn, be used to develop energy infrastructure as well as water supply and sanitation infrastructure in order to achieve progress in broad-based sustainable development.

The way forward

In the medium- to long-term, mobilizing domestic public finance is a critical element in supporting infrastructure investment in countries with special needs. Improved tax administration and broadened tax bases would expand the fiscal space of Governments, while significant resources could also be mobilized through user charges. Increasing the efficiency of public expenditure would also expand the fiscal space available to countries with special needs.

A clear identification of potential partners, financial instruments and necessary government support measures, based on the nature of infrastructure projects, would greatly improve the efficiency of the infrastructure development process. Budget provision should also identify how much infrastructure should be financed. Such information will help Governments to clarify their development objectives and strategies as well as assist their development partners to align their cooperation for infrastructure development with the priorities of countries with special needs.

The development of capital markets has the potential to facilitate a more efficient allocation of the regional savings pool, including in the private sector, in order to generate long-term financing for investment. The greater variety of financial instruments that would become available through capital markets should help countries with special needs to make infrastructure more attractive for a broader group of investors, and should allow for better diversification of risks. However, developing capital markets in economies with small populations or small domestic markets may be unrealistic due to a lack of economies of scale. In such cases, pursuing regional capital markets may be a more relevant strategy. Moreover, the availability and use of new financing options is unlikely to lead to better outcomes in countries with weak governance and institutional capacity

ACKNOWLEDGMENTS

The *Asia-Pacific Country with Special Needs Development Report* is a flagship publication of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP).

This report was prepared under the overall leadership and guidance of Shamshad Akhtar, Under-Secretary-General of the United Nations and Executive Secretary of the Economic and Social Commission for Asia and the Pacific. Hongjoo Hahm, Deputy Executive Secretary, provided valuable advice and comments. The report was coordinated by a core team under the direction of Hamza Ali Malik, Officer-in-Charge, Macroeconomic Policy and Financing for Development Division. The core team, led by Oliver Paddison, included Sudip Ranjan Basu, Andrzej Bolesta, Naylin Oo and Yusuke Tateno.

ESCAP staff who contributed substantively include: Alper Aras, Shuvojit Banerjee, Jose Antonio Pedrosa Garcia, Steve Gui-Diby, Alberto Isgut, Zheng Jian, Daniel Jeongdae Lee, Vatcharin Sirimaneetham, Tientip Subhanij and Mathieu Verougstraete of the Macroeconomic Policy and Financing for Development Division; Hong Peng Liu (Officer-in-Charge), Kohji Iwakami and Jun Tian of the Energy Division; Stefanos Fotiou (Director), Kyungkoo Kang, Aida Karazhanova and Ram Tiwaree of the Environment and Development Division; Tiziana Bonapace (Director), Tae Hyung Kim and Alexey Kravchenko of the Information and Communications Technology and Disaster Risk Reduction Division; Margarita F. Guerrero (Director), Arman Bidarbakht Nia and Eric Hermouet of the Statistics Division; Nagesh Kumar (Director), Cai Cai, Sayuri Cocco Okada and Marco Roncarati of the Social Development Division; Susan F. Stone (Director), Masato Abe, Witada Anukoonwattaka, Soo Hyun Kim, Mia Mikic and Tengfei Wang of the Trade, Investment and Innovation Division; Yuwei Li (Director) Edouard Chong and Peter O'Neill of the Transport Division; Adnan Aliani (Director) and Chrispin Kapinga of the Strategic Programme Management Division; Kilaparti Ramakrishna (Head), Nobuko Kajiura and Dorothea Lazaro of the ESCAP Subregional Office for East and North-East Asia; Nikolay Pomoshikov (Officer-in-Charge), Elvira Mynbayeva, Hiroaki Ogawa and Lyazzat Palymbetova of the ESCAP Subregional Office for North and Central Asia; Iosefa Malava (Head) and Sanjesh Naidu of the ESCAP Subregional Office for the Pacific; and Matthew Hammill (Officer-in-Charge) and Nyingtob Pema Norbu of the ESCAP Subregional Office for South and South-West Asia; Mitchell Hsieh and Lorenzo Santucci of the Office of the Executive Secretary.

The following consultants provided inputs: Rajiv Biswas, Asia-Pacific Chief Economist, IHS Markit, Singapore; Santi Chaisrisawatsuk, Director, Center for Development Economics studies, National Institute of Development Administration, Thailand; Selim Raihan, Professor, Department of Economics, University of Dhaka, and Executive Director, South Asian Network on Economic Modelling (SANEM), Bangladesh; Shuanglin Lin, Professor and Director, China Centre for Public Finance National School of Development, Peking University, People Republic of China and Yuqing Ariel Yu, Senior Policy Researcher, Institute for Global Environmental Strategies, Thailand. Monica Das, Associate Professor, Skidmore College, New York, USA has provided valuable technical inputs to the report as well as Julian Vella, Partner and Asia Pacific Head of Global Infrastructure, KPMG.

The report also benefited from the discussions at the Expert Group Meeting on the regional implementation of the Vienna Declaration and Programme of Action for landlocked developing countries held on 30 November 2016 at ESCAP. Staff of the United Nations, and specialized agencies and related organizations included: Amelia Santos-Paulino, Landlocked Developing Countries' Section, Division for Africa, least developed countries and Special Programmes, UNCTAD, Geneva; Mazen Gharzeddine, Policy Specialist, UNDP, Bangkok; Bjorn Johannessen, Senior Engineer on Employment-Intensive Investments, Regional Office for Asia and the Pacific, ILO, Bangkok; Jintipaporn Saiprom, Project Assistant, UNIDO, Bangkok; Chanin Manopiniwes, Infrastructure

Economist, East Asia and Pacific, World Bank, Bangkok.

The eminent group of policymakers, scholars and development practitioners at the Expert Group Meeting were: Ehsan Shayegan, Founder and CEO of Porsesh Research and Studies Organization, Afghanistan; Varduhi Asaturian, Head, United Nations Desk, Ministry of Foreign Affairs, Armenia; M. Yunus, Senior Research Fellow, Bangladesh Institute of Development Studies, Bangladesh; Md. Zahangir Alam, Joint Secretary, Economic Relations Division, Ministry of Finance, Bangladesh; Mirza Ashfaqur Rahman, Deputy Chief, General Economic Division, Planning Commission, Bangladesh; Zannatul Ferdous, Senior Assistant Secretary, Economic Relations Division, Ministry of Finance, Bangladesh; Nima Tshering, Lecturer, Institute for Excellence and Development, Bhutan; Korm Ribaun, Deputy Secretary-General, National Committee for ESCAP, National Council of Ministers, Cambodia; Ing Sokun, Deputy Director and Member of NSDP Secretariat, Ministry of Planning, Cambodia; Neelesh Gounder, Senior Economics Lecturer, Economics of Institutions, Tourism Economics, Trade and Trade Liberalization in Development, University of South Pacific, Fiji; Aleksandre Papiashvili, Senior Investment Adviser, and Akaki Adamia, Investment Adviser, Georgian National Investment Agency, Georgia; Odbayar Erdenetsogt, Interim Director, International think-tank for landlocked developing countries, Mongolia; Khin Naing Oo, Rector, Yangon University of Economics, Myanmar; Posh Raj Pandey, Chairman, South Asia Watch on Trade, Economics and Environment, Nepal; Khojamakhmad Umarov, Head of Macroeconomic Department, Center of Economic Studies, Tajikistan; Supattra Auearee, Development Affairs Division, Department of International Organizations, Ministry of Foreign Affairs, Thailand; Ma'U Leha, Principal Economist, Ministry of Finance and National Planning, Tonga; Sharofiddin Nazarov, Centre for Economic Research, Uzbekistan; Kunagorn Kunavut, ICT Infrastructure Specialist, Thailand; Nonarit Bisonyabut, Research Fellow, Economic Governance Programme, Thailand Development Research Institute (TDRI), Thailand; Jason Reynold, former Director, National Economic Planning Office, Ministry of Finance and Economic Development, Kiribati; Saman Kelegama, Executive Director, Institute of Policy Studies of Sri Lanka, Colombo, Sri Lanka; Kwang Hoon Lee, Assistant Professor, Department of Public Administration, Kangwon National University, Republic of Korea; Syed Nuruzzaman, International Consultant, Bangladesh; and Don Clarke, International Consultant.

Walaiporn Laosuksri of the Macroeconomic Policy and Financing for Development Division, ESCAP, provided research assistance. Valuable inputs were also received from individual contractors, Amir Radfah, Candice Branchoux and Mahesh C. Uniyal, and from interns Lin Fang, Lucas Scally and Vincent Tanutama.

The manuscript was edited by Robert A. R. Oliver. The graphic design was created by QUO Bangkok, Ltd. with the support and facilitation of Ricardo Dunn, Martin Dessart and Sompot Suphutthamongkhon of the ESCAP Strategic Publications, Communications and Advocacy Section. The layout and printing were provided by Clung Wicha Press.

Pannipa Jangvithaya, Achara Jantarasaengaram, Kiatkanid Pongpanich, Pimolmas Piyanuwatchareon, Woranooch Thiusathien, Nucharat Tuntiwigit and Sutinee Yeamkitpibul of the Macroeconomic Policy and Financing for Development Division undertook all administrative processing necessary for the publication of this report.

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EXPLANATORY NOTES

Analyses in the *Asia-Pacific Countries with Special Needs Development Report 2017* are based on data and information available up to the end of March 2017.

Groupings of countries and territories/areas referred to in the present issue of the Report are defined as follows:

- Countries with special needs: least developed countries, landlocked developing countries and small island developing States.
- ESCAP region:
  - ESCAP member States: Afghanistan; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Democratic People's Republic of Korea; Fiji; Georgia; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Zealand;; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.
  - Associate members: American Samoa; Cook Islands; French Polynesia; Guam; Hong Kong, China; Macao, China; New Caledonia; Niue; and Northern Mariana Islands
- Developing ESCAP region: ESCAP region excluding Australia, Japan and New Zealand.
- Developed ESCAP region: Australia, Japan and New Zealand.
- Least developed countries: Afghanistan, Bangladesh, Bhutan, Cambodia, Kiribati, Lao People's Democratic Republic, Myanmar, Nepal, Solomon Islands, Timor-Leste, Tuvalu and Vanuatu.
- Landlocked developing countries: Afghanistan, Armenia, Azerbaijan, Bhutan, Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Mongolia, Nepal, Tajikistan, Turkmenistan and Uzbekistan.
- Small island developing States:
  - ESCAP member States: Fiji, Kiribati, Maldives, Marshall Islands, Micronesia (Federated States of), Nauru, Palau, Papua New Guinea, Samoa, Singapore, Solomon Islands, Timor-Leste, Tonga, Tuvalu and Vanuatu.
  - Associate members: American Samoa, Cook Islands, French Polynesia, Guam, New Caledonia, Niue and Northern Mariana Islands.
- Pacific: American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Marina Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.
- Due to the limited availability of data, associate members of ESCAP are excluded from analysis by the Report unless otherwise indicated.
- Singapore is not considered as a small island developing State in the Report because of its high level of development, high-income status and for simplicity of analysis.

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Growth rates are on an annual basis, except where otherwise indicated.

Reference to "tons" indicates metric tons.

References to dollars ($) are to United States dollars, unless otherwise stated.

The term "billion" signifies a thousand million. The term "trillion" signifies a million million.

In the tables, two dots (..) indicate that data are not available or are not separately reported; a dash (-) indicates that the amount is nil or negligible; and a blank indicates that the item is not applicable.

In dates, a hyphen (-) is used to signify the full period involved, including the beginning and end years, and a stroke (/) indicates a crop year, fiscal year or plan year.

ACRONYMS

AAAA	Addis Ababa Action Agenda
ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
APII	Access to Physical Infrastructure Index
ASEAN	Association of Southeast Asian Nations
BRI	Belt and Road Initiative
CSN	countries with special needs
DAC	OECD's Development Assistance Committee
ESCAP	United Nations, Economic and Social Commission for Asia and the Pacific
FDI	foreign direct investment
GDP	gross domestic product
GTAP	Global Trade Analysis Project
HDI	Human Development Index
ICT	information and communications technology
IEA	International Energy Agency
IMF	International Monetary Fund
IPoA	Istanbul Programme of Action for the Least Developed Countries
km	kilometre
kWh	kilowatt-hour
LDCs	least developed countries
LLDCs	landlocked developing countries
MDBs	multilateral development banks
NDB	New Development Bank
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
OOF	other official flows
PPPs	public-private partnerships
SDGs	Sustainable Development Goals
SIDS	small island developing States
SOEs	state-owned enterprises
SPECA	United Nations, Special Programme for the Economics of Central Asia
UNCTAD	United Nations Conference on Trade and Development
UN-OHRLLS	United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States
VPoA	Vienna Programme of Action for Landlocked Developing Countries
WHO	World Health Organization
WSS	water supply and sanitation

INTRODUCTION

Building resilient and quality infrastructure is critical for countries with special needs (CSN), comprising least developed countries, landlocked developing countries and small island developing States, in the Asia-Pacific region to overcome their structural bottlenecks and to promote sustainable development. The infrastructure deficit is already high in the region, with infrastructure-related assets that are too overstretched, and often of poor quality, to provide efficient services to the region's citizens. At the same time, demand for more infrastructure continues to grow due to increasing urbanization and expanding populations, which are leading to aggravated traffic congestion, greater air pollution and increased concerns for waste management.

To raise the financial resources required for infrastructure development, and to identify and maximize the impact of infrastructure development, policymakers need to mainstream sustainable, resilient and equitable infrastructure solutions into national policymaking so that it meets people's needs and, at the same time, supports social development and protects the environment. In this context, the term 'infrastructure' is an all-encompassing concept that can be related to physical structures, institutions and human capabilities. It can also be related to economic, social or environmental dimensions of development, where: (a) economic infrastructure includes transportation, energy, communications and financial services systems; (b) social and environmental infrastructure includes water and sanitation, schools, hospitals and health-care systems; and (c) institutional infrastructure includes the facilities, equipment and personnel required for service delivery and governance.[1]

This report focuses on physical infrastructure, which includes physical structures (primarily transport, energy/power, information and communications technology, water supply and sanitation), and on overcoming challenges that are related to financing the development of such infrastructure in CSN.

To highlight the importance of infrastructure in inclusive growth and sustainable development in countries with special needs, this report describes four main issues: (a) the relevance of infrastructure in global development agendas such as the 2030 Agenda for Sustainable Development, global programmes of action for least developed countries, landlocked developing countries and small island developing States, and the Addis Ababa Action Agenda on Financing for Development, among others; (b) a conceptual framework that describes the linkages between infrastructure and sustainable development; (c) a presentation of a Physical Infrastructure Access Index to better understand linkages between access to infrastructure to human development and poverty reduction; and (d) estimating economic impacts of infrastructure.

The discussion in this section is aimed at emphasizing that physical infrastructure is critical for inclusive growth and sustainable development. In this regard, while significant improvements have been made across the CSN in providing access to physical infrastructure in areas such as transport, energy, information and communications technology (ICT), and water supply and sanitation (WSS), significant divergences still exist within CSN compared to other developing and developed countries in Asia and the Pacific. Moreover, achievements have often failed to benefit marginalized and vulnerable groups.

It must also be noted that the development of social and institutional infrastructure is equally important to bringing

Box A. Social and institutional infrastructure in countries with special needs

Social infrastructure

It is critical that the Asia-Pacific CSN expand investments in education and health. In particular, further development of technical and vocational skills would reduce the mismatch between the skills that workers have and those that employers are looking for – in many CSN this mismatch is particularly large. The Asia-Pacific aggregate figure for the percentage of technical/vocational programmes in secondary education is 10.7 per cent, while for the least developed countries as a group the figure is only 2.2 per cent; Afghanistan, Bhutan, the Lao People's Democratic Republic and Nepal have figures that range below 1.2 per cent. Given that in many least developed countries the working-age population continues to grow, there is a window of opportunity to reap the benefits of the demographic dividend by strengthening the development of technical and vocational skills, thereby setting up national skill-development policies to ensure that new demand is fulfilled.

As discussed in ESCAP (2016a) developing the requisite policy emphasis in infrastructure is essential to enhancing productivity in the CSN. This includes training teachers and reducing class sizes. For example, least developed countries have a pupil-teacher ratio in secondary education of 31:1, which is significantly higher than the Asia-Pacific average figure of 19:1 and almost double the LLDC figure of 16:1. As for the percentage of trained teachers for secondary education, according to national standards it is 67.5 for the least developed countries, as opposed to 88.9 per cent in landlocked developing countries. However, average figures mask large variations that exist at the national and subnational levels, which raises concerns about realizing Goal 10 on reducing inequality. For example, those from the lowest wealth quintile are overrepresented in out-of-school populations; in the Lao People's Democratic Republic, this quintile has a rate of 28 per cent, while that for the highest wealth quintile is a mere 3 per cent. This imposes large costs. In Timor-Leste, this cost has been estimated to be more than 4 per cent of GDP, a figure that does not account for non-income benefits of primary education such as improved health and civic engagement.

Many factors that play important roles in developing social infrastructure relate to Goal 3 (good health and well-being). For example, the postponement of marriage and child bearing, with smaller family sizes, is known to have a positive impact on human capital formation, such as investments in education and being able to address gender inequities, as covered by Goal 5 (Gender Equality). For example, in the case of human resources in the health-care sector, the data on the number of physicians (per 10,000 population) indicate that in most of the least developed countries the figure is around 1-2. Tuvalu, with a figure of 11 is the exception. In contrast, in landlocked developing countries such as Armenia, Azerbaijan and Mongolia, the respective figure exceeds 25, which is still far below that of other developing countries in the region.

Institutional infrastructure

Institutional infrastructure in areas such as rules, regulations and governance is closely linked to the ways in which well-functioning governance structures support the mainstreaming of policies, rules and regulations to improve the efficient utilization of resources for infrastructure development. In particular, it also includes the facilities, equipment and personnel required for public service delivery to improve economic growth as well as ensure sustainable development. For example, with a robust institutional framework, policymakers can ensure an enabling business environment to speed up implementation for improved project contracting and a better protection of property rights.

Strengthening the quality of institutional infrastructures expands the scope for creating a more efficient public expenditure framework and for strengthening revenue allocation modalities. Strengthening institutional architectures at the national level thereby contributes to an expansion of fiscal space and can also enhance the prospects of acquiring additional financing resources for infrastructure spending, especially in CSN economies.

Furthermore, there is scope in the CSN to improve institutional architectures to allow a more flexible and effective delivery of resilient infrastructure by improving overall coordination at the national level. Stability and predictability in policymaking are key elements in ensuring that institutions thrive and engage effectively in decision-making processes across ministries and stakeholders. Multi-stakeholder engagement and participatory governance structures are cornerstones for harnessing infrastructure-related policy, planning and financing instruments, and to thereby move towards achieving sustainable development.

Source: ESCAP (2017a) and ESCAP, ADB and UNDP (2017).

about changes in making progress towards the Sustainable Development Goals (see box A). For example, several targets of the 2030 Agenda for Sustainable Development emphasize the links between infrastructure development, health and education outcomes, and access to services for women.[2] Without such social dimensions of infrastructure, countries cannot employ the necessary human resources to foster inclusive growth and sustainable development. Institutional infrastructure is also highlighted in the 2030 Agenda as being necessary for: (a) reducing poverty; (b) regulating agricultural development; (c) establishing warning systems for health risks; (d) achieving gender equality; (e) enabling local communities to administer water resources; (f) regulating and monitoring of financial markets; (g) introducing disaster risk reduction strategies; (h) regulating of small-scale fisheries; and (i) strengthening the rule of law and justice system.

Complementing the analysis by the *Economic and Social Survey of Asia and the Pacific 2017* (ESCAP, 2017a) which revolves around a theme of importance of governance in development, this report highlights the fact that governance also plays an important role in determining how effectively economic policies, including those for infrastructure development, can be administered. Indeed, in this context, the analysis in this report demonstrates that the impact of infrastructure on levels of income per capita and on human development, is higher in countries where property rights (used as a proxy for governance) are higher.

A. Infrastructure in global mandates and programmes of action

The focus of national and international policymaking on enhancing productive capacities, especially to increase opportunities for productive employment, is critical to achieving sustainable development, particularly for the CSN. This is highlighted in the global support programmes, i.e., the Addis Ababa Action Agenda, the Istanbul Programme of Action for least developed countries, the Vienna Programme of Action for landlocked developing countries, and the small island developing States Accelerated Modalities of Action (SAMOA) Pathway, which are aimed at supporting these countries in overcoming their development challenges; each highlight the importance of diversifying production bases and undergoing a process of domestic economic transformation by strengthening infrastructure. Doing so will help diversify export bases, strengthen fiscal revenues, and reduce vulnerabilities to commodity price fluctuations and the negative impact of extreme weather events and climate change. A high priority is also accorded to infrastructure in the 2030 Agenda, in which infrastructure development and investment are directly connected to the goals and actions areas.

The 2030 Agenda for Sustainable Development, which comprises 17 Sustainable Development Goals (SDGs) with 169 targets, has devoted Goal 9 to the priority of building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation. This goal thus aims to develop reliable, sustainable and resilient infrastructure that is of good quality. This includes regional and cross-border infrastructure to support economic development and human well-being, with a focus on affordable and equitable access for all. It further highlights the fact that by 2030, there will mechanisms to facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support, particularly to help least developed countries, landlocked developing countries and small island developing States overcome such large differences that these countries face in terms of infrastructure development vis-à-vis developed and other developing countries. In this context, Goal 9 further emphasizes the need to support domestic technology development, research and innovation in developing countries, including by ensuring that the policy environment is conducive to, inter alia, industrial diversification and value addition to the export of raw commodities.

Within the Addis Ababa Action Agenda (AAAA), member States agreed to establish the Global Infrastructure Forum to bridge infrastructure gaps and highlight opportunities for investment and cooperation as well as to ensure that investments are environmentally, socially and economically sustainable. In doing so, the Forum should improve "alignment and coordination among established and new infrastructure initiatives, multilateral and national development banks, United Nations agencies, and national institutions, development partners and the private sector".[3] This will also help to promote linkages between Goal 9 and the process of industrialization and innovation, especially for CSN.

While the AAAA recognizes that public and private investment plays a critical role in raising financial resources for infrastructure financing, it also highlights other sources such as development banks, development finance institutions, and tools and mechanisms such as blended finance. New sources of financing also require clear strategies for policymakers to improve their financial market infrastructure in areas such as rules and regulations in order to enhance their risk-sharing frameworks.

The Istanbul Programme of Action (IPoA) for the Least Developed Countries for the Decade 2011-2020 also highlights the importance of infrastructure within its eight priority areas. For example, the first priority ("Priority A") explicitly promotes infrastructure and energy; the fifth priority ("Priority E") underscores the importance of water and sanitation; the sixth priority ("Priority F") highlights climate change and environmental sustainability as well as disaster risk reduction. In relation to infrastructure, the discussion in IPoA refers to transport, ICT and energy infrastructure, while water and institutions as well as good governance are each noted separately. IPoA expands upon the energy sectors separately in Priority A and also calls for more spending and country-led policies to support infrastructure development for least developed countries.

The Vienna Programme of Action (VPoA) for Landlocked Developing Countries for the Decade 2014-2024 highlights in the second of its six priorities the importance of infrastructure development and maintenance. It states that key infrastructure areas are related to transport, energy and ICT, and notes that infrastructure is a prerequisite for the transfer of scientific knowledge between countries through international institutions, by referring to the need to build schools and research centres as well as the improvement of ICT infrastructure through, for example, telephones and access to the Internet. One of the key financing mechanisms is to explore possibilities of public-private partnerships to finance long-term infrastructure projects, particularly those that are of a cross-border nature.[4]

The small island developing States Accelerated Modalities of Action (SAMOA) Pathway 2014-2024 highlights several ways to increase the availability of infrastructure and improve its quality through investment, particularly in priority areas such as (a) climate change, (b) sustainable energy, (c) disaster risk reduction and (d) water and sanitation. The agenda also specifically emphasizes the importance of transport, electricity and ICT.

Addressing infrastructure development will enable the CSN in the region to achieve the multiple objectives of the 2030 Agenda, the AAAA and their respective programmes of action.

B. A framework for integrating infrastructure for sustainable development

Infrastructure is a multi-dimensional concept that provides sector-wide and country-wide benefits, thus having an impact on the economic, social and environmental dimensions of sustainable development. To capture the importance of infrastructure to sustainable development, this report develops an analytical framework, demonstrating the direct and indirect impacts that an effective plan and implementation framework for strengthening infrastructure can have on the Sustainable Development Goals (SDGs). Indeed, the 2030 Agenda highlights the need to develop quality infrastructure that is reliable, sustainable and resilient, and outlines several guiding principles:

(a) Infrastructure plans and implementation must be inclusive to ensure that no-one is left behind and that it generates decent jobs and enhances access, among other aspects, to transportation, energy, ICT, and water supply and sanitation;
(b) Infrastructure projects must be designed to be climate-friendly. Policies must be aimed at reducing CO_2 emissions by focusing sustainable solutions for the energy and transport sectors;
(c) Infrastructure must be resilient to climate change;
(d) Infrastructure should nurture seamless connectivity to promote economic integration in the region, as this will provide a much-needed impetus to trade and investment flows, which are currently held back due to infrastructure bottlenecks; and
(e) Infrastructure efficiency should be enhanced through the adoption of emerging sustainable technologies, which should be an integral part of developing new infrastructure systems.

Under these principles, infrastructure across all sectors serves a common purpose, i.e., to deliver services to people as well as empower and connect them. Deficiencies of infrastructure thus present a bottleneck to economic growth, a risk to business competitiveness, a factor contributing to growing inequality, an obstacle to poverty reduction, and an impediment to effectively pursuing SDGs and other internationally agreed development goals.

Development and maintenance of infrastructure services is critical to overcoming several constraints that CSN in Asia and the Pacific face in effectively pursuing SDGs. Improving access to infrastructure services boosts economic activities and produces spillover effects in various productive sectors. This raises growth opportunities at the national level, and creates space for raising public revenue that can be used for further development expenditure. However, with the lack of infrastructure availability, economic growth suffers and this has a negative impact on the possibility of raising public revenues. Therefore, while inadequate infrastructure leads to a vicious cycle of weak public services and disincentives for private sector investment for economic activities, improving infrastructure helps Governments to generate revenue by strengthening growth. The additional revenue, in turn, can be invested

in order to enhance inclusive economic growth and sustainable development, thereby creating a virtuous circle and enabling CSN to benefit from cross-border seamless connectivity via regional transport, ICT and energy networks

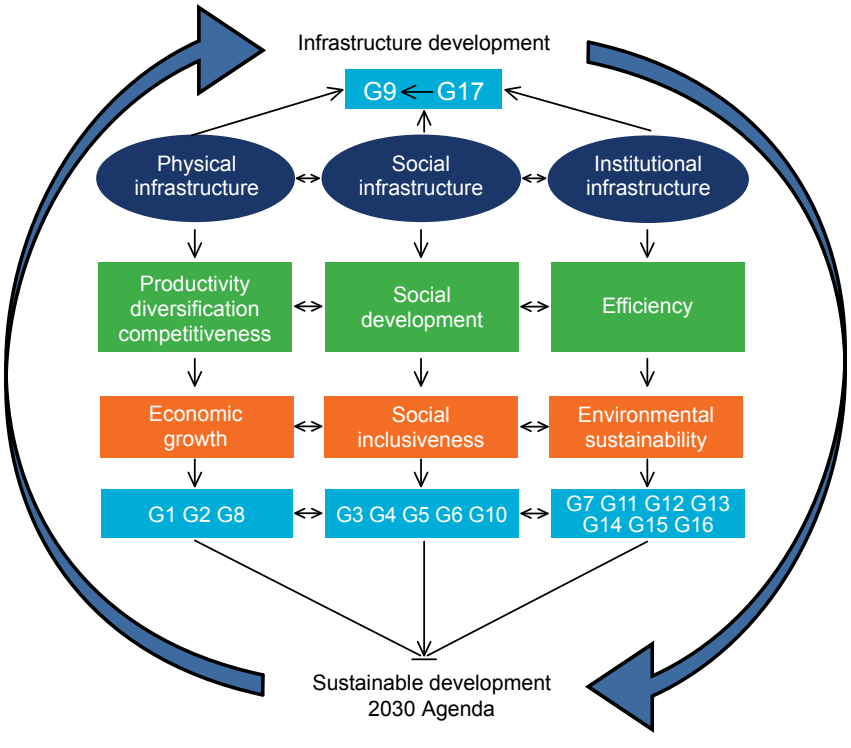
In particular, investing in infrastructure can promote productivity growth through various transmission mechanisms. In the short term, building infrastructure boosts aggregate demand through increased construction activity and the creation of employment. In the long term, infrastructure investment can boost economic growth by increasing the supply capacity of an economy (World Bank, 2012).[5] Infrastructure development and maintenance have several policy implications due to their nature and sustained financing needs. Thus, in order to recognize the significance of their benefits and multiplier effects, project planning for infrastructure needs to consider the following public policy aspects: (a) public goods; (b) spillover effects; (c) time horizon of the project cycle; (d) project partnership; and (e) national policy frameworks.

These benefits of strengthening infrastructure are amplified through the complementary relationship with other factors of production, particularly private sector investment. Thus, in infrastructure projects at the national level, cost-effective solutions underline the fact that the public sector needs to effectively manage risks upfront by ensuring that incentives and business conditions are conducive to private sector participation. This also requires that appropriate governance structures are in place, especially in procurement processes, to enhance the impact of private sector investment in developing sustainable infrastructure.

While there are many factors that can foster private sector involvement in the financing of resilient and sustainable infrastructure, improving infrastructure also promotes private investment, which in turn increases the durability of capital goods, helps industries to achieve economies of scale and scope, reduces transaction costs and promotes integration into the world economy through global value chains.[6]

Especially in countries where financial resources for infrastructure development are limited, as is the case in many CSN, leveraging private sector involvement will contribute to making public capital expenditure more efficient. Indeed, the efficiency-adjusted approach demonstrates that the productive capacity of public capital has largely been underestimated when employing traditional methods to measure the role of public capital stock (Gupta and others, 2014). Other studies have noted that the impacts of closing the public investment efficiency gap are substantial since improving the efficiency of the lowest quartile to the highest can double the effects

Figure A. Conceptual framework on infrastructure for sustainable development



Source: ESCAP.

Note: G1-G17 denote the Sustainable Development Goals of the 2030 Agenda. See annex I for the complete list of the Goals.

of public investment on growth (IMF, 2015). Similarly, evidence also emphasizes the efficiency of public investment as (efficiency-adjusted) public capital is a significant contributor to growth (Gupta and others, 2014; IMF, 2014). However, it is worthwhile noting that countries with low public capital efficiency can also generate high returns on investment since those countries usually lack capital (Berg and others, 2015).

Moreover, the impacts of public investment on infrastructure, controlling for the quality of public capital, are particularly significant in developing countries as greater infrastructure investment helps primary industries move towards more advanced stages of development (Bhattacharya, Oppenheim and Stern, 2015). Therefore, policies on infrastructure investment need to be examined within the broader context of public policymaking in order to encourage a design of policies that complement each other in enhancing efficiency.

Figure A depicts an integrated framework in which actions such as strengthening of physical, social and institutional infrastructure can accelerate economic growth, social development and environmental sustainability, thereby helping to achieve sustainable development. In particular, strengthening (a) physical infrastructure investment related to transport, energy, information and communications technology, water supply and sanitation, (b) social infrastructure in health and education, and (c) and institutions by improving policies and rules and regulations, will have a positive impact on economies. The impact will include: (a) increasing GDP growth and employment generation through enhanced connectivity and production networks; (b) fostering social development through improved access to public services and new opportunities; and (c) improving environmental sustainability through low-carbon, resource-efficient and climate-resilient societal order.

Indeed, the academic literature confirms a close link between infrastructure, economic growth and poverty reduction. For example, a large number of theoretical and empirical studies have pointed to the substantial positive impacts of infrastructure development on economic growth (United Nations, 2016). Studies have found a unidirectional causality from infrastructure to output growth from 1975 to 2007 (Sahoo, Dash and Nataraj, 2010). Additionally, a long-term positive impact on economic growth may be obtained by investments in power and telecommunications (Egert, Kozluk and Sutherland, 2009).

Infrastructure not only serves as an additional input of public capital for the production of goods and services, it also enhances total factor productivity and economic competitiveness by reducing the cost of doing business and allowing a more effective use of limited resources. Investing in infrastructure also has a multiplier effect as it stimulates other capital investment, including in the private sector, resulting in further economy-wide productivity growth and a subsequent improvement of social development. In particular, by increasing investment, infrastructure development contributes to improved mechanisms for reducing rural-urban development gaps. It also boosts jobs and raises real wages. Furthermore, a greater focus on social infrastructure investment can enhance access to basic social services, especially for the most marginalized and vulnerable groups of communities.

Importantly, evidence points to linkages between infrastructure and inclusive growth, meaning that improvements of infrastructure not only ensure economic growth, but also contribute to poverty reduction and social development (Zhan, 2015). While infrastructure has substantial impacts on growth that may vary across countries, time, and within infrastructure subsectors (see, for example, Estache and Garsous, 2012, and Dissou and Didic, 2013), infrastructure development can also promote growth spillovers to neighbouring countries (Roberts and Deichman, 2009). Importantly, investments in water supply, sanitation and roads are critical to growth and have benefited the poor in East Asia and the Pacific (Jones, 2004; van der Geest and Nunez-Ferrer, 2011). At the country level, numerous studies have shown that infrastructure development leads to sustained economic growth and is a significant factor for reducing poverty. This has, for example, been demonstrated in Bangladesh (Raihan, 2011), China (Fan and Zhang, 2004), Philippines (Llanto, 2013), India (Nagar and Basu, 2002), Papua New Guinea (Gibson and Rozelle, 2003), Fiji (ADB, 2011) and Kazakhstan (ADB, 2013).

Infrastructure also has a differential effect on the living conditions of low-income groups, as affordable public services help low-income households to access productive opportunities as well as improve their health and education outcomes (Calderon and others, 2014). Empirical evidence on the role of infrastructure in addressing inequality is inconclusive since researchers find that the extent to which infrastructure contributes to poverty reduction varies across countries.[7] However, the positive impact of consumption services is clear – since expenditure on water and electricity takes up a great proportion of low-income households' budgets, lowering the cost of paying for these services benefits more people at the lower end of the income distribution than at the upper end (United Nations, 2016).

Providing access to basic infrastructure is also critical to harnessing women's empowerment and gender equality. Thus, greater access to physical infrastructure reduces the time needed to do household activities and allows women to devote more time to paid work and community activities that can improve their social status (ESCAP, 2015b; ADB, 2015a). However, different types of infrastructure alleviate women's poverty in various ways, depending upon the sector-specific impacts of infrastructure. For example, increased connectivity through transportation infrastructure in rural areas could help women and girls by (a) improving access to health and education services as well as markets, and (b) enhancing employment opportunities (including short-term employment in construction and road maintenance). Of course, the risks include greater exposure to trafficking and child protection issues for young women and girls. In this regard, enhancing capacities to assist policymakers in integrating gender concerns into national infrastructure planning and budgetary processes, in order to advance women's empowerment and enhance their access to infrastructure services, may be required.

Improving physical and social infrastructure also empowers rural and other disadvantaged communities to participate in the development process. Importantly, greater focus on investment in improving the efficiency of policies, and rules and regulations is critical for infrastructure development in CSN in the region. Connecting people through infrastructure projects has large spillover effects. To this end – with many rural communities in CSN lacking access to modern energy, and demonstrating reliance on expensive, carbon-intensive fuel or traditional biomass for cooking – renewable energy provided through appropriate national and regional policy frameworks can enhance energy access, reduce dependency on imports, mitigate climate change, improve health conditions (especially for women and children) and mitigate inequality – a clear pathway towards the implementation of the 2030 Agenda.

Attention therefore needs to be given to developing and maintaining infrastructure with appropriate integrated strategies and planning frameworks at the national level. In the CSN in particular, policymakers can explore synergies between economic and social benefits or environmental sustainability in choosing infrastructure projects. Indeed, policymakers need to build resilient infrastructure to ensure that various sectors and related policies receive enough attention, rather than focusing only on the aspects of infrastructure development and its maintenance (United Nations, 2016; ESCAP, 2014).

At the regional level, there is a need for advocating an integrated approach to improving infrastructure access by addressing all four areas of infrastructure – i.e., transport, energy, ICT, and WSS – in the context of regional economic integration and connectivity in order to ensure increased economic, social and environmental benefits. Enhancement of regional infrastructure systems must focus on affordability, efficiency and environmental sustainability, while policies that promote these increases must focus on inclusive growth and sustainable development. In this way, overall development of infrastructure can play a catalytic role in stimulating economic growth, promoting social inclusion and accelerating the achievement of the SDGs in the region, especially in the CSN.

This report is structured as follows. Chapter 1 provides details on the current state of physical infrastructure in countries with special needs. In doing so, it highlights some of the challenges that CSN are facing in the Asia-Pacific region in terms of providing access to important infrastructure sectors. Recognizing the multi-dimensional character of infrastructure, chapter 2 presents the ESCAP Access to Physical Infrastructure Index for helping to provide a quantitative assessment of infrastructure availability in countries with special needs and for use as a policy tool for infrastructure development policies. The chapter also points to the large infrastructure deficit that CSN in the region are facing. With this large deficit in mind, chapter 3 estimates the financial resources that countries would need to invest in closing infrastructure gaps with other countries in the region. As these are significant and far exceed the resource availability in CSN, the chapter explores what options these countries have for closing or bridging the gaps. The way forward concludes the report.

ENDNOTES

1 For additional information, see United Nations (2016).

2 Indeed, the overall development of several Asia-Pacific countries such as Japan, the Republic of Korea, Singapore and, more recently, China and Malaysia is largely attributed to forward-looking and progressive education policies. Large government investments were made in the provision of education and health services, which prepared each country's workforce – often allowing the reaping of benefits from demographic dividends – for globalization-induced, high-wage manufacturing jobs.

3 The 2017 Forum, held on 22 April in Washington. D.C., focused on financing sustainable infrastructure, including its link to climate change. It also provided opportunities for more extensive involvement of national development banks and institutions. Under the overarching theme of "Delivering inclusive sustainable Infrastructure", it highlighted sustainable infrastructure in support of cross-border/regional integration.

4 In line with the 2030 Agenda and VPoA, the United Nations Special Programme for the Economies of Central Asia (SPECA) provides a subregional platform for effectively addressing special needs of seven Asian landlocked developing countries, i.e., Afghanistan, Azerbaijan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. The Ganja Declaration, adopted by the 2016 SPECA Governing Council, emphasized the importance of intergovernmental cooperation to enhance regional infrastructure connectivity in transport, energy and ICT as well as the -food-energy-ecosystems nexus in support of the 2030 Agenda. The SPECA Economic Forum and six thematic working groups actively support cooperative efforts for transborder infrastructure development and policy harmonization in this region. The six thematic working groups comprise gender and economy, knowledge-based development, statistics, trade, transport and border crossing as well as water, energy and the environment. More information is available at http://www.unescap.org/resources/ganja-declaration.

5 See ESCAP (2016a), in which the importance of adequate and efficient infrastructure services for growth and productivity is reviewed.

6 The World Bank (2012) shows that public spending on infrastructure raises the marginal product of factor inputs, since private property such as machinery and vehicle, can be used more productively when supported by public infrastructure. See also UNCTAD (2013), Zhan (2015) and McKinsey Global Institute (2016).

7 Previous research has noted that the provision of paved roads does not significantly benefit rural residents in Nepal but largely benefits rural economy in India (Raychaudhuri and De, 2010). In particular, the impact of safe and reliable public transport in rural areas in India boosts women's participation in the MGNREGA employment guarantee scheme.

CHAPTER 1

CURRENT STATE OF PHYSICAL INFRASTRUCTURE IN COUNTRIES WITH SPECIAL NEEDS

Economic conditions, geographic characteristics and demographic features of countries with special needs differ considerably as do their institutional capacities, which are critical in prioritizing and sequencing infrastructure development and maintenance as well as selecting the most appropriate modality for financing these needs. Given the variation of these characteristics among the CSN and the differences in their level of development, the quality and type of infrastructure needs vary significantly in least developed countries, landlocked developing countries and small island developing States.

To highlight these differences, this chapter reviews, identifies and analyses the priorities and challenges that CSN face in terms of infrastructure needs. For example, some countries need to close significant infrastructure gaps with a particular view to lowering trade costs and thereby strengthening value chains. This is particularly relevant to least developed countries (OECD and WTO, 2013). In contrast, while least developed countries and small island developing States are more likely to need to improve their physical infrastructure to primarily strengthen social infrastructure, landlocked developing countries need to join regional infrastructure networks as part of regional connectivity and integration, and thus improve the flow of goods and services across borders.

To identify the challenges and opportunities for infrastructure development that CSN are facing, this chapter also reviews national development plans, sustainable development strategies, and infrastructure policies of CSN. It identifies priorities for infrastructure development and maintenance in the CSN in the region and discusses the importance of sequencing investment.

The inadequate development of infrastructure and maintenance of existing infrastructure in the CSN has resulted in large infrastructure deficits in those countries. For example, of the 400 million people living in the 36 CSN of the region, 133 million people still lack access to improved water sources in rural areas; 74 million people lack access to improved sanitation; 144 million people lack access to electricity; and 320 million people (out of 392 million people in 23 CSN) lack access to the Internet. The CSN therefore need to improve the availability and quality of infrastructure. Indeed, SDG 9 emphasizes the development of good quality, reliable, sustainable and resilient infrastructure, including regional and cross-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all through enhanced financial, technological and technical support.

The progress and challenges of infrastructure development do not completely explain infrastructure performance, which describes how effectively infrastructure services are provided to consumers over the long term. Thus, even though some countries may face greater development challenges than others, they may demonstrate better infrastructure performance than countries that are naturally more 'advantaged'.

As there are some striking contrasts across the region in terms of availability of infrastructure that is considered critical for the implementation of the 2030 Agenda for Sustainable Development, this chapter presents several infrastructure indicators to reflect the current state of transport infrastructure, energy infrastructure, ICT infrastructure, and WSS in CSN in the region. In doing so, it also compares the availability of such infrastructure among the different groupings of CSN, and how they compare to other developing countries and the developed countries in the region. This may serve to later identify individual infrastructure priorities of the heterogeneous group of CSN.

A. TRANSPORT

Well-developed transport networks reduce transportation costs and time-to-market for a competitive and efficient economy as well as improve the physical accessibility by many households in the region to essential products, both goods and services. They also enhance resource allocation efficiency. Sustainable transport systems therefore play a critical role in economic and social development by: (a) providing access to economic and social opportunities; (b) facilitating the movement of people, goods, labour, resources, products and ideas; (c) creating market opportunities for both consumers and producers; (d) enabling manufacturers to take advantage of locational strengths; and (e) allowing the expansion of supply chains across borders. The mobility of goods and people plays an important role in social and economic development, promoting gains from trade as well as the exchange of knowledge. Hence, key transport sectors, i.e., roads, railways, seaports, airports, dry ports and other transport infrastructure, make a key contribution to growth (World Bank, 2006).

1. Road transport

Physical links across Asia and the Pacific have improved in recent years. In part, this is due to steady investments in the Asian Highway network, the Trans-Asian Railway, and through the facilitation of land transport projects, which have resulted in a network of 143,000 kilometres of roads and highways (ESCAP, 2013) being developed across the region. However, road density (measured in kilometres of road per 1,000 km^2 of land area) is quite low in the CSN, particularly in those economies that cover vast areas of

land (such as Kazakhstan and Mongolia; see figure 1.1). Indeed, in all the CSN, except Azerbaijan, Bangladesh and Samoa, road density falls below the regional average of developing countries that are not among the CSN.

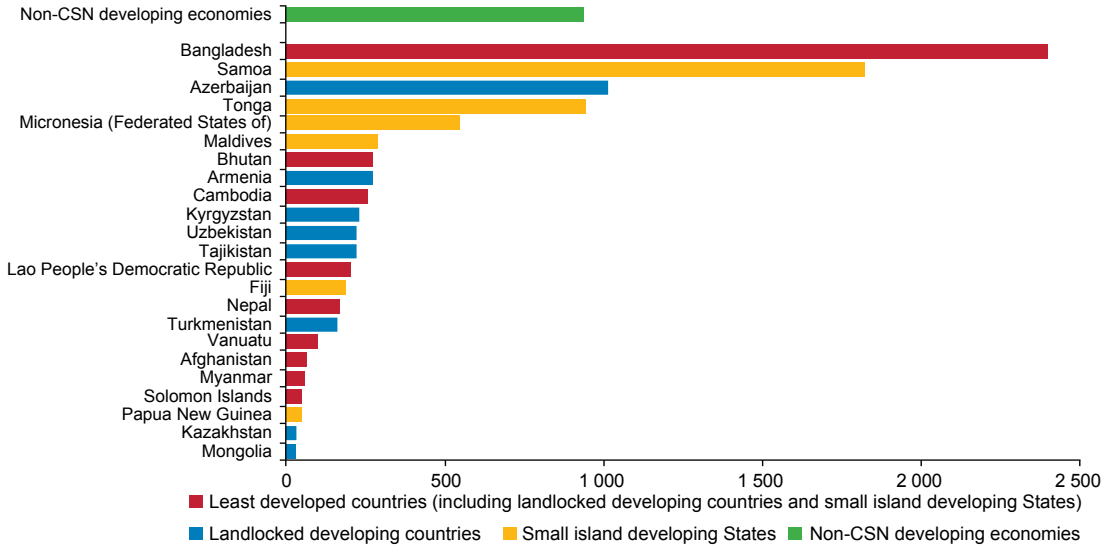
Moreover, patterns on road density are inconclusive in describing the level of access of the population or assessing the quality of the infrastructure. For example, in Bangladesh less than 10 per cent of the road network is paved while for Samoa the figure is less than 15 per cent; Azerbaijan has the second lowest paved percentage of all landlocked developing countries (figure 1.2). While the quality of roads is important for all countries, it is particularly so for landlocked developing countries, which rely on land connections to access world markets. In this regard, the highway routes comprising the Asian Highway network are of varying quality, which is a major cause for concern, with only 25,392 km out of a total of 128,027 km falling under Class 1 category.[1]

As in most other developing countries, transport networks in CSN are usually government- owned. In most countries, policies and funding for new transport infrastructure takes priority over maintenance and operations. For example, many countries only spend between 20 per cent and 50 per cent of what would be required to maintain their road network (Burningham and Stankevich, 2005). Therefore, the quality of existing infrastructure is quite poor in many countries. This is especially the case in least developed countries, which face a multitude of pressing expenditure priorities, but which have very limited financial resources. Indeed, a large proportion of road networks in the CSN is unpaved. In all seven least developed countries with available data, less than 60 per cent of road infrastructure is paved, which is in contrast to landlocked developing countries (except Mongolia; see figure 1.2). For example, Myanmar has a trunk road network of 40,000 km, of which only 53 per cent has a sealed surface, while a further 40 per cent is in bad or very bad condition due to limited investment in the road sector and a lack of maintenance. Although road sector budgets have increased significantly in recent years, Governments often lack the institutional and technical capacity for maintenance planning and budgeting, resulting in inadequate budget allocations for maintenance and suboptimal utilization of available maintenance funding (ADB, 2015a). Most Asian landlocked developing countries, particularly in Central Asia, have a higher percentage of paved roads than the regional average of other developing economies in the region. The limited data available for small island developing States pose a challenge in analysing the state of road infrastructure of these countries. However, according to the available data, most small island developing States except Maldives have conditions similar, or even worse, than those in least developed countries.

2. Rail transport

Rail transport also plays a crucial role for developing countries, particularly landlocked developing countries that are major exporters of mineral resources. Due to its relatively larger size, Fiji is the only small island

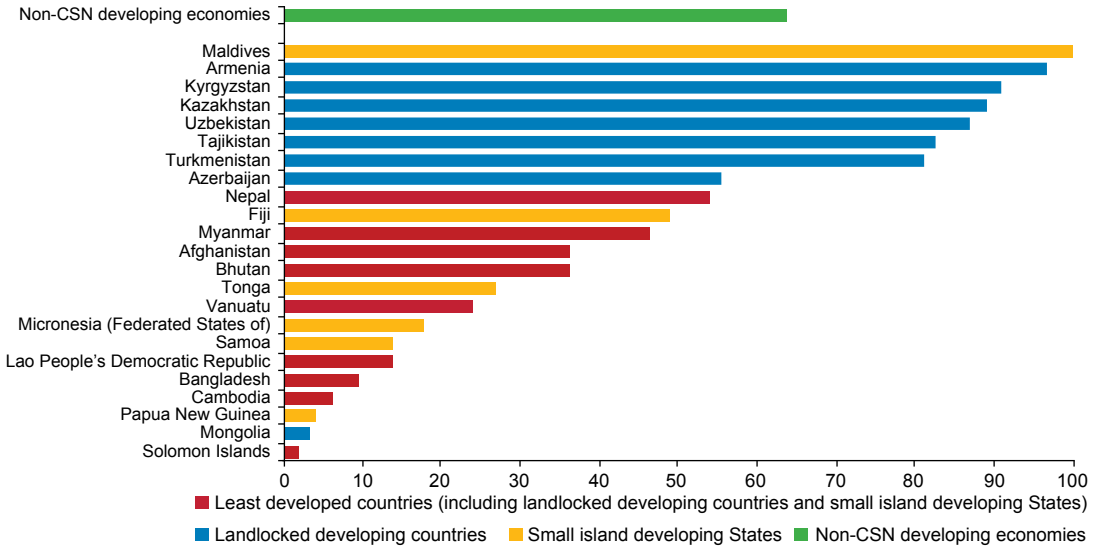
Figure 1.1. Road density (kilometres per 1,000 km² of land area), 2013-2015



Sources: ESCAP calculations based on the ESCAP statistical database, available at www.unescap.org/stat/data/statdb/DataExplorer.aspx; World Development Indicators, available at http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators; and data on land areas from Food and Agriculture Organization, available from www.fao.org/faostat/en/#home (accessed 10 January 2017).

Note: Road density is the ratio of the length of the country's total road network to the country's land area.

Figure 1.2. Paved roads (percentage of roads) in countries with special needs, 2012



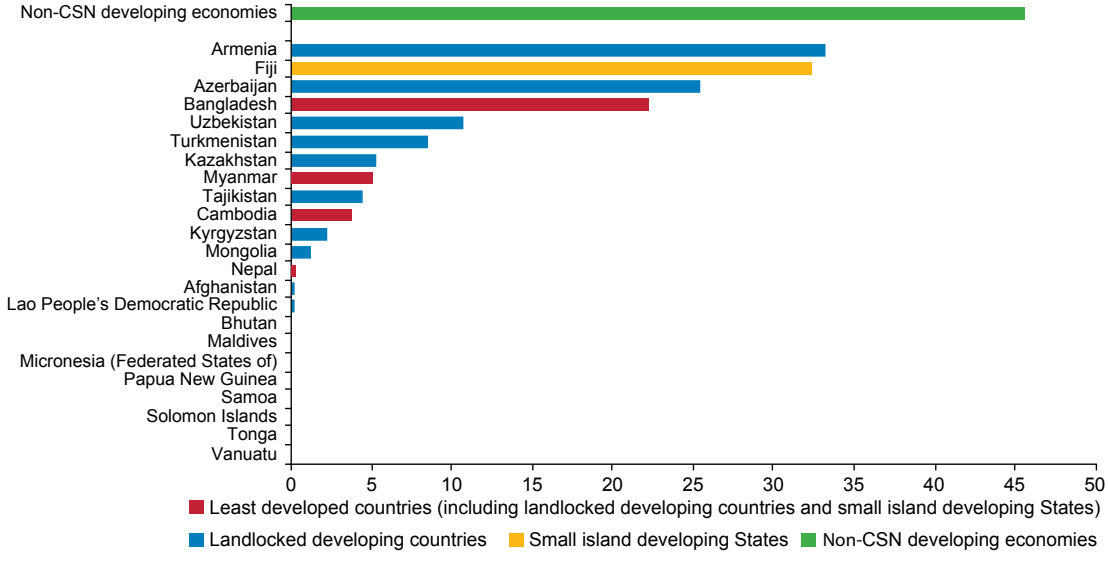
Source: ESCAP calculations based on the latest available data from the ESCAP statistical database, available at www.unescap.org/stat/data/statdb/DataExplorer.aspx (accessed 10 October 2016).

Note: Paved roads refers to better roads i.e., level 4 or above roads.

developing States with a rail system – indeed, air and maritime transportation are more relevant to small island developing States – while among the least developed countries, Bangladesh, Cambodia, Myanmar and Nepal have some rail tracks (figure 1.3). The Lao People's Democratic Republic, which currently has very little rail transport, has now embarked upon a construction mega-project of a high-speed rail link between Kunming (China) and the Lao capital, Vientiane.

The efficiency of rail transport in the CSN is, however, hampered by the existence of different technical standards across the region as well as the absence of several critical "missing links" in its rail infrastructure, which are preventing the rail network from functioning as a continuous system (ESCAP, 2014).[2] Indeed, there are currently an estimated 10,900 km of missing links in the Trans-Asian Railway (TAR) network, representing 9.3 per cent of the identified network. With 42 per cent

Figure 1.3. Rail lines density (kilometres per 1,000 km² of land area), 2013-2015



Source: ESCAP calculations based on data from the World Bank, Transportation, Water, and Information and Communications Technologies Department, Transport Division, available at http://data.worldbank.org/indicator/; data on land areas from Food and Agriculture Organization, available at www.fao.org/faostat/en/#home (accessed 20 November 2016).

of the missing links, ASEAN is the least rail-connected subregion, however, all subregions are affected to some degree by the existence of missing links, in particular landlocked developing countries.

This therefore highlights the fact that significant additional investment in transport infrastructure is required in the CSN in order to enhance market connectivity and reduce transport times, particularly for roads linking rural and urban centres. Indeed, in recent years, policy emphasis has shifted from transport infrastructure extension to upgrading, maintaining and improving road management efficiency, which is underscored by the fact that quality infrastructure is included in the 2030 Agenda for Sustainable Development, particularly in Goal 9.

3. Air and maritime transport

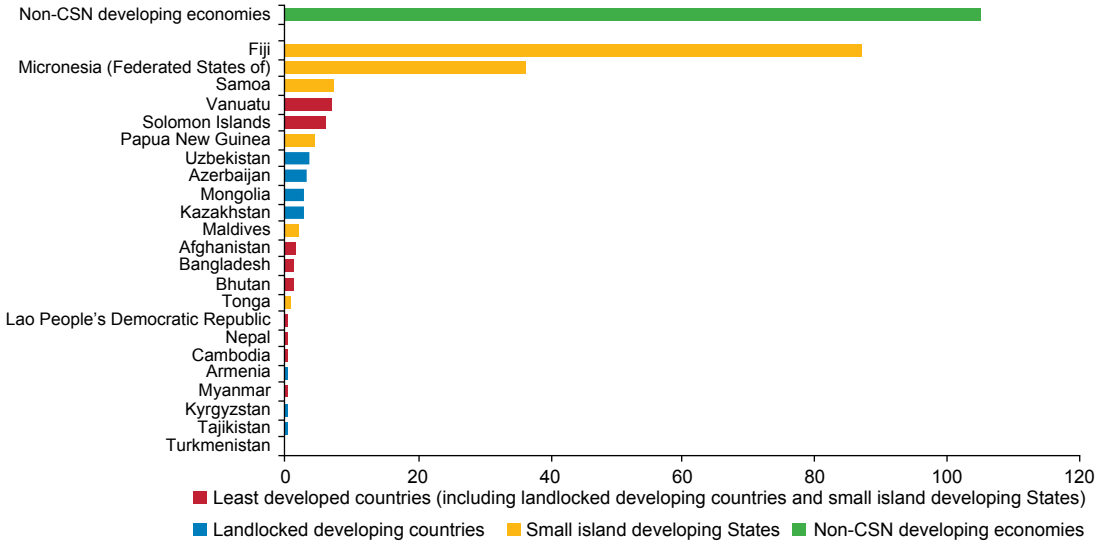
Air and maritime transportation are important components of infrastructure, particularly to small island developing States. Overall, air transport infrastructure has seen improvements in the CSN due to the construction of new airports and improvements of existing airports. Among the landlocked developing countries, for example, Bhutan has emphasized the importance of equipping the eastern part of its territory with air transport by 2020 to promote economic activities such as tourism. Similarly, air transport could be improved in Mongolia by increasing the range of services and its enhance competitiveness. Maldives has also embarked on a massive expansion of its international airport increase capacity to 7.5 million passengers annually.

Small island developing States have developed their air transportation conditions significantly during the past few decades and have the highest air transport indicators among CSN (figure 1.4). However, they are still plagued by high transport costs, which is limiting their competitiveness, such that there is still room for further improvement. Moreover, for the CSN as a whole, air transport (as measures by freight per million inhabitants) falls far below the average for other developing countries in the region.

Maritime transport is also important for many CSN as it can contribute to improving their export potential. Unsurprisingly, small island developing States have the highest number of seaports, given the importance of domestic and international maritime transport to them (figure 1.5). For example, Papua New Guinea's domestic maritime infrastructure provides urban and rural populations with opportunities to access to education, health and economic activities, while international ports contribute to the country's economic growth by facilitating resource exports. However, most of its ports and jetties are in poor condition due to lack of maintenance.

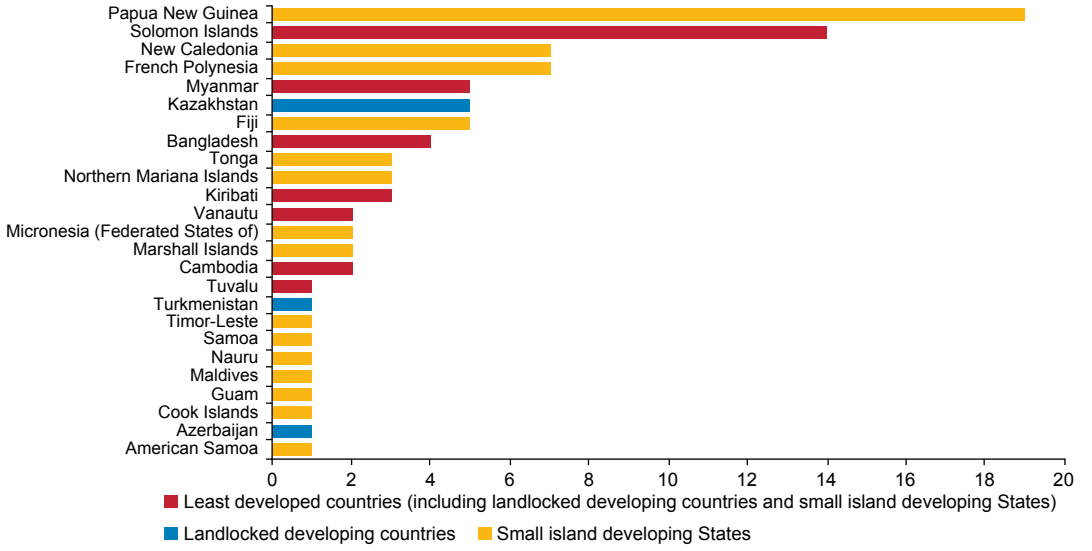
Some of the landlocked developing countries are exploring ways to access maritime services, either by leasing or by constructing actual seaports. For example, Mongolia is developing the water transport sector by leasing a seaport in China and encouraging private sector participation and investment in the sector. While Kazakhstan is also working on leasing terminals in ports of China, the Islamic Republic of Iran, the Russian Federation and European Union countries, it is also conducting trade

Figure 1.4. Air transport, freight (million tons-km) per 1 million inhabitants



Source: ESCAP calculations based on data from the International Civil Aviation Organization's Civil Aviation Statistics of the World, and ICAO staff estimates, available at www4.icao.int/newdataplus/ (accessed 20 November 2016).

Figure 1.5. Number of seaports in country with special needs



Source: World Port Source, available at www.worldportsource.com/countries.php (Accessed 15 November 2016).

with the European Union countries using the seaports in the Caspian Sea.

Countries are also developing dry ports to support regional trade. The Intergovernmental Agreement on Dry Ports, developed with the support of ESCAP, entered into force on 23 April 2016, after 8 of the 17 signatory countries became party to the Agreement.[3] Such dry ports, of which there are 240 in 27 countries in the region, are essential to the advent of efficient intermodal transport corridors that offer a framework within which issues related to trade, transport, technologies as well as social and environmental concerns can be addressed in an inclusive manner. Supporting progress in dry ports is timely, as the capacities of existing infrastructure in maritime ports are, in many cases, limited, while operation costs are high and new facilities are urgently required.

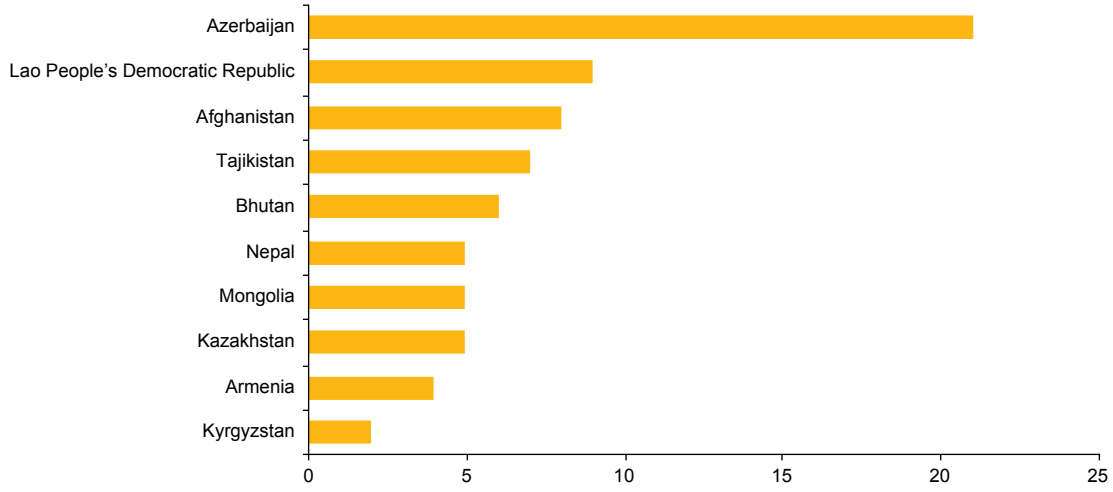
Well-managed dry ports, particularly those located at a significant distance from a seaport, help to reduce transportation costs and total transit time. This feature is particularly important for remote hinterland areas and landlocked developing countries. A number of landlocked developing countries have started to implement projects for developing modern facilities or upgrading existing ones (figure 1.6). For example, recognizing that an important factor in unlocking trade is the availability of adequate logistics facilities and services, the Governments of China and Kazakhstan have been cooperating on the development of the "Khorgos-East Gate" free economic area located in the south-east of Kazakhstan and just one kilometre away from Kazakhstan's border with China. The Government of Uzbekistan has also taken a number of initiatives to develop intermodal corridors and dry ports in the country, with facilities being located along major subregional road, rail and aviation routes to capitalize on the country's transit potential. Bhutan also plans to develop a dry port on the border with India by 2020 in order to raise the competitiveness of their exports by reducing damage and losses in transit as well as the cost of imports with decreased travel time.

There is also a significant potential for ICT to augment dry ports. For example, by running fibre-optic cables along the Asian Highway, and Trans-Asian Railway, ICT infrastructure will converge at dry ports (many of which are already located or planned for location along these intermodal transport corridors). However, it is no easy task due to the number and variety of stakeholders and to the difficulties in securing the necessary financing. Coordination among different government ministries/departments and the private sector is important to creating an environment that is conducive to the development of dry ports.

B. ENERGY

The availability of energy is a prerequisite to economic growth, just as energy services contribute to social development by, for example, improving education and health outcomes.[4] Indeed, modest increases in per capita electricity use are usually associated with much larger improvements in human development, demonstrating that energy plays a more significant role in countries at an intermediate stage of economic development than

Figure 1.6. Number of dry ports of international importance earmarked for development by Governments of landlocked developing countries



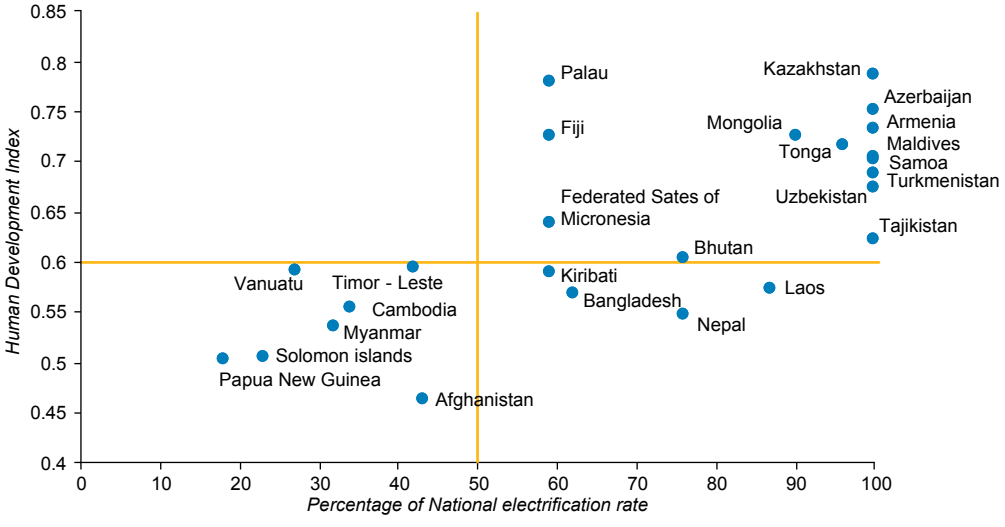
Source: United Nations, Economic and Social Commission for Asia and the Pacific. Bridging Transport, ICT and Energy Infrastructure Gaps for Seamless Regional Connectivity. ST/ESCAP/2703 (Bangkok, 2014).

those that are fully developed (International Energy Agency, 2004).

Access to electricity is particularly important for countries with a low level of human development. Thus, none of the countries with a national electrification rate lower than 50 per cent have a human development index (HDI) that is higher than 0.6 (figure 1.7). In contrast, the group of countries that have an HDI of more than 0.6 all have a national electrification rate of 60 per cent or higher. Although access to electricity is not the only determining factor of HDI, the fact that the electrification rate and HDI are not linearly correlated shows that access to electricity plays a more crucial role for countries that are at a low-to-medium development stage than those that are at the medium-to-high development stage.

The CSN face unique challenges in energy infrastructure due to geographical constraints, limited access to modern energy-related technology, and low levels of economic, social, and human development. Almost one-half (45 per cent), equivalent to approximately 140 million people, of the population living in CSN in the Asia-Pacific region do not have access to electricity. Most live in least developed countries, including 60 million in Bangladesh, 36 million in Myanmar, 17 million in Afghanistan and 10 million in Cambodia.

Figure 1.7. National electrification index and human development index



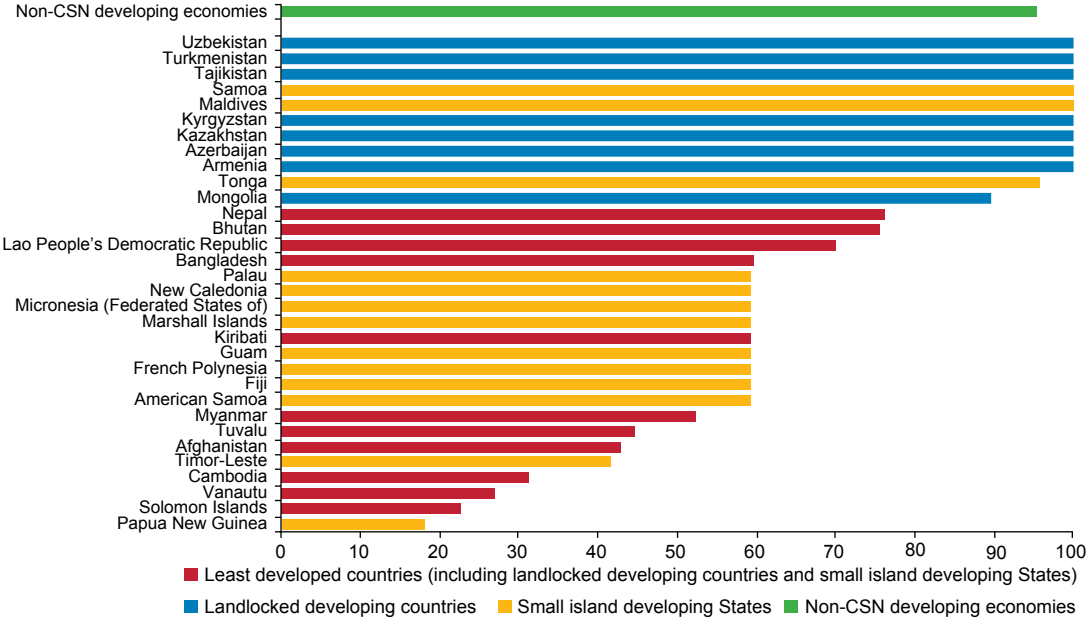
Source: ESCAP calculations based on data from World Bank database, available at http://data.worldbank.org/indicator/ (accessed January 2017).

Providing access to energy is particularly challenging for small island developing States due to their archipelago character. For example, in Papua New Guinea, which comprises more than 600 islands, the national electrification rate is only 18 per cent. In Solomon Islands, where 350 islands are inhabited, the national electrification rate is 23 per cent (figure 1.8). In contrast, in small island developing States that have much fewer dispersed islands, such as Nauru and Niue, access to electricity is almost universal. There are also wide disparities among landlocked developing countries. Thus, while access to electricity in landlocked developing countries that are not least developed countries is universal (with the exception Mongolia where, due to its vast geographic size and low population density, 89.8 per cent of the population had access to electricity in 2012), landlocked developing countries that are also least developed countries have electrification rates that range between 43 per cent and 75 per cent of the population.[5] Many CSN are not only struggling to meet basic energy needs through access to electricity for lighting, but also to provide access to non-solid fuels for cooking and heating. In terms of access to electricity, only three of the region's 12 least developed countries – Bhutan, Nepal and the Lao People's Democratic Republic, which are also landlocked developing countries – have access rates above the average rate for all CSNs of 60 per cent (figure 1.8). Although some of the region's least developed countries, such as Myanmar and Timor-Leste, are resource rich countries, their main national income depends on those resources and their Governments have not been able to supply energy to all. Consequently, access rates are quite low. In part, this may also be due to the fact that both countries were, until recently, affected by conflict.

The small island developing States, particularly those that are also classified as least developed countries, also have low rates of access to electricity. The fact that most of these countries are archipelagos increases the challenges and costs of universally providing electricity. The importance of geography in providing electricity is indeed underlined, considering that all landlocked developing countries (with the exception Afghanistan) have electrification rates that are above the CSN average, and seven landlocked developing countries are providing universal access to electricity. Other countries are lagging quite behind in providing 100 per cent electrification, especially in Papua New Guinea, where only 18 per cent of the total population have access to electricity, followed by Solomon Islands (22.8 per cent), Vanuatu (27.1 per cent) and Cambodia (31.1 per cent).

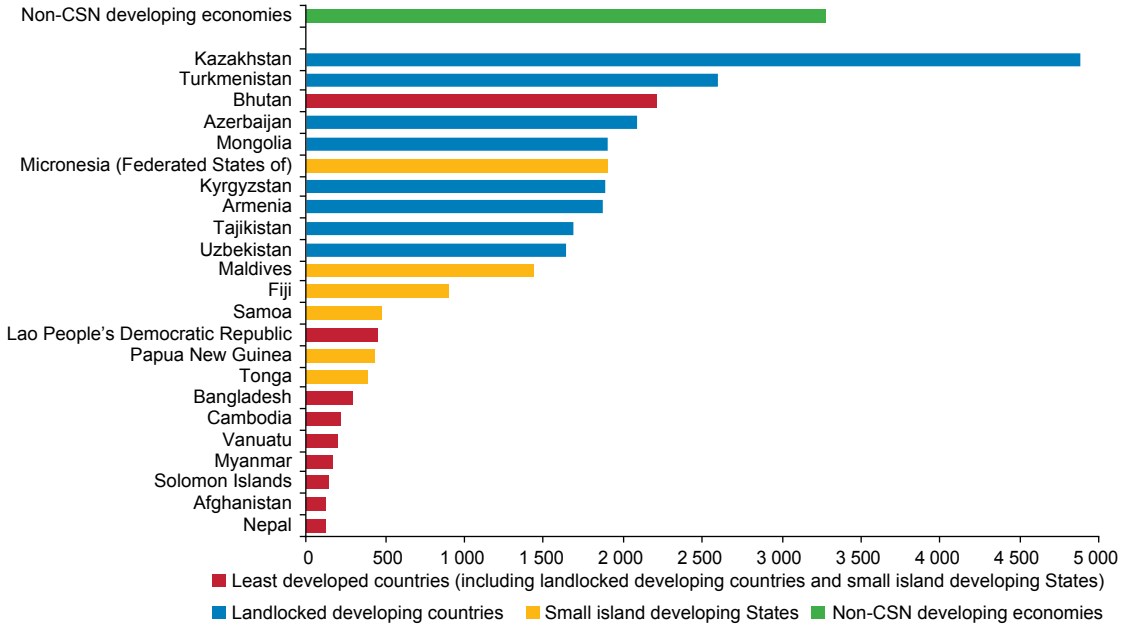
Electric power consumption per capita is much higher in the Asian landlocked developing countries than in Asia-Pacific least developed countries (figure 1.9). One reason why the levels of electricity usage are low in least developed countries is the low rate of electrification.

Figure 1.8. Access to electricity (percentage of population), 2013-2015



Source: ESCAP calculations based on data from World Bank and Global Electrification database, available at Sustainable Energy for All (SE4ALL) at www.se4all.org/ (accessed 20 November 2016)

Figure 1.9. Electric power consumption (kWh per capita), 2012-2015

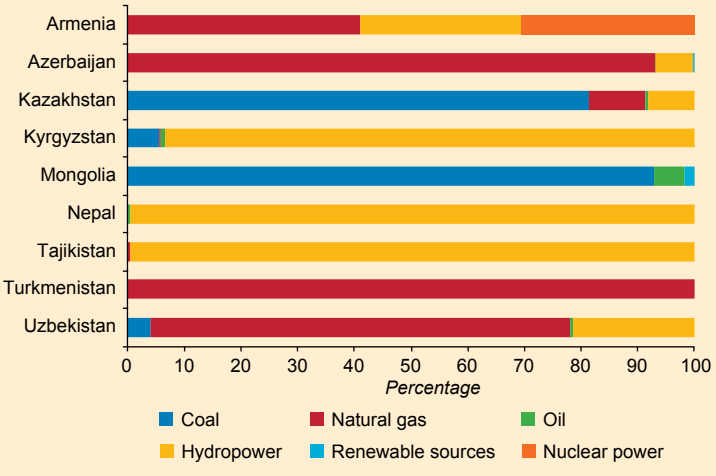


Source: International Energy Agency Statistics, available at www.iea.org/stats/index.asp (accessed 20 November 2016).

Box 1.1. Alternative sources of energy

While the demand for energy is growing rapidly in the region, countries are seeking to diversify their energy supply. For example, among the least developed countries the Lao People's Democratic Republic aims to become the hydropower "battery" of Asia, and its electricity exports have already increased sharply. Myanmar also has abundant hydropower as well as natural gas resources, and their development is vital to reducing poverty and supporting economic growth. In Nepal, where energy access targets include a commitment to meeting SDG-7 in order to provide affordable, reliable, sustainable and modern energy for all, almost the entire amount of energy produced is through hydropower. This is also the case in Tajikistan, which high rates also measures in Kyrgyzstan (figure A). In Armenia, almost a third of the total electricity was generated by hydropower plants in 2007, a quarter by thermal power plants and 43.3 per cent by Armenia's nuclear power plant. The energy system fully meets the domestic demand for electricity and maintains certain potential for electricity exports.

Figure A: Sources of energy production, selected economies



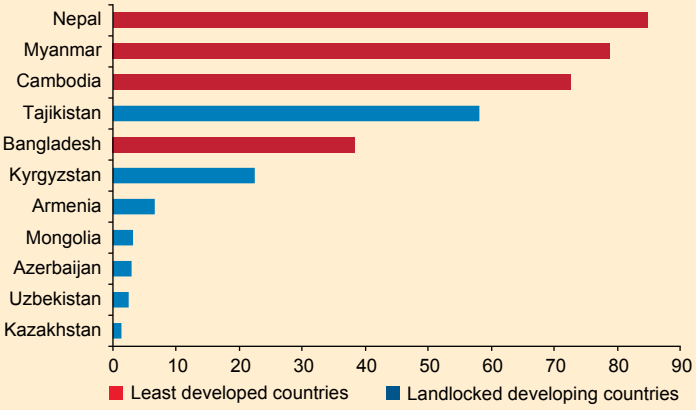
Source: World Bank World Development Indicators based on availability of the latest year's data available at http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (accessed November 2016).

Box 1.1. *(continued)*

Access to non-solid fuels is quite poor in the CSN such that large proportions of their populations rely on solid fuel for cooking and heating. For example, in the Lao People's Democratic Republic, only 2.4 per cent of the population has access to non-solid fuel; in Timor-Leste, the ratio is slightly higher at 6.8 per cent. In Myanmar, Solomon Islands, Bangladesh, Cambodia, Vanuatu, Afghanistan and Nepal, access to non-solid fuel 7.3, 8.7, 10.9, 11.4, 15, 19.5 and 20.5 per cent, respectively. Only Turkmenistan has 100 per cent access to non-solid fuel.

The share of renewable energy in total final energy consumption varies significantly among CSN, ranging from 1 per cent in Tonga to 90 per cent in Nepal (figure B). However, a closer look reveals that most of the countries with a higher percentage of renewable energy in total energy consumption actually rely heavily on traditional solid biofuel. For example, traditional solid biofuel contributed to 77.7 per cent of final energy consumption in Bhutan, followed by 73.5, 72.7, 55.3 and 43.9 per cent, respectively, in the Lao People's Democratic Republic, Myanmar, Cambodia and Papua New Guinea. In other words, these countries have a higher share of renewable energy not because they are employing modern and clean technology but because they are using renewable resources in a traditional way, which is both polluting and inefficient.

Figure B: Share of renewable energy in total final energy consumption (per cent), 2012



Source: ESCAP calculations based on data from International Energy Agency (IEA) statistics and balances, available at http://data.iea.org/payment/products/103-world-energy-statistics-and-balances-2016-edition.aspx (accessed November 2016).

C. INFORMATION AND COMMUNICATIONS TECHNOLOGY

As highlighted in the 2030 Agenda for Sustainable Development, the spread of information and communications technology (ICT) has great potential in accelerating human progress by bridging the digital divide and developing knowledge societies. ICT is the key to accelerating achievement of SDGs. For example, increased mobile and broadband Internet penetration with reduced costs can transform the way public services such as health (Goal 3) and education (Goal 4) are delivered via e-Health applications and e-Learning platforms. Overall, the 2030 Agenda refers to ICT infrastructure as a cross-cutting 'Means of Implementation.' Already, advances in ICT have been instrumental in shaping and leading a socio-economic transformation across Asia and the Pacific, as ICT infrastructure enables people to access and share information, as well as communicate with one another. Moreover, telecommunications infrastructure is a necessary element of effective governance in countries with thinly spread and isolated populations.

Specifically, at the global level, SDGs include specific ICT-related targets. For example, target 9.1 is the development of 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 addition, the means of implementation 9.c calls for a significant increase in access to ICT and strives to provide universal and affordable access to the Internet in least developed countries by 2020.

Although number of subscriptions for fixed telephone lines has been decreasing around the world due to the rise of mobile/cellular services, fixed-telephone subscriptions remain a critical infrastructure indicator as they provide a

basis for upgrading fixed-broadband infrastructure. In this regard, a relevant indicator to capture ICT infrastructure is to add the number of fixed and mobile telephone subscriptions per 100 persons of a population.

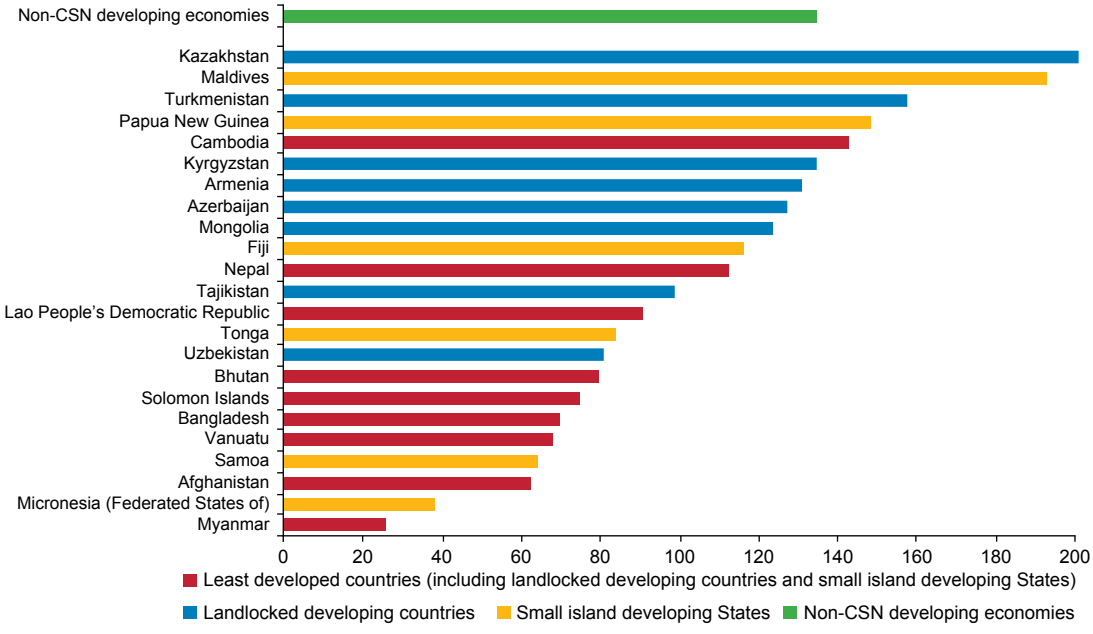
Increasing connectivity and use of ICT can support efforts to pursue sustainable development and inclusive growth through improving infrastructure. Although growth in access to the telecommunications, especially the mobile and Internet infrastructure has increased steadily, the percentage of those with access remains low in most of the CSN. Indeed, only a few CSN, such as Kazakhstan, Maldives, Turkmenistan, Papua New Guinea and Cambodia have subscription rates above that of other developing economies (figure 1.10).

Telephone penetration is particularly low in most least developed countries. However, while Myanmar ranks lowest according to available data, mobile penetration saw tremendous growth in 2015 and 2016, such that mobile penetration was recently estimated to have reached 90 per cent. Indeed, since Myanmar's telecoms revolution began in 2014, the number of Internet users has risen from 2 million to more than 39 million, while the number of SIM cards for mobile phones in circulation has risen by almost 400 per cent, according to government figures (Nyunt, 2016). This suggests that leapfrogging is possible in ICT infrastructure by introducing and adoping new and modern technology.

Having access to the Internet is a further important indicators of ICT infrastructure. The Internet has transformed the way we live by providing instant connectivity to the remotest areas of the world and transmission of data, information and knowledge in multiple formats and languages over fibre-optic cables, wireless networks or satellites. ICT-enabled financial, transport and trade facilitation infrastructure will be essential to encouraging innovations and developing an inclusive digital economy in the region. Broadband-enabled technologies, such as smart grids, intelligent transport systems, integrated water management systems and Single Windows are some of the efficient approaches that will drive growth in all sectors of the economy. This emerging infrastructure is built on broadband networks and facilitates the movements of goods, services, people and money across countries, thereby acting as building blocks of the emerging digital economy.

Figure 1.11 shows that Internet penetration is particularly low in least developed countries, while several of the landlocked developing countries perform quite well. This is partly due to the fact that promoting ICT infrastructure investment in non-economic viable areas of the least developed countries (mostly the rural communities or isolated outer islands) is very challenging. Several fibre-optic missing links in some CSN, particularly in least developed countries, are due to the fact that the unconnected areas are not economically viable for

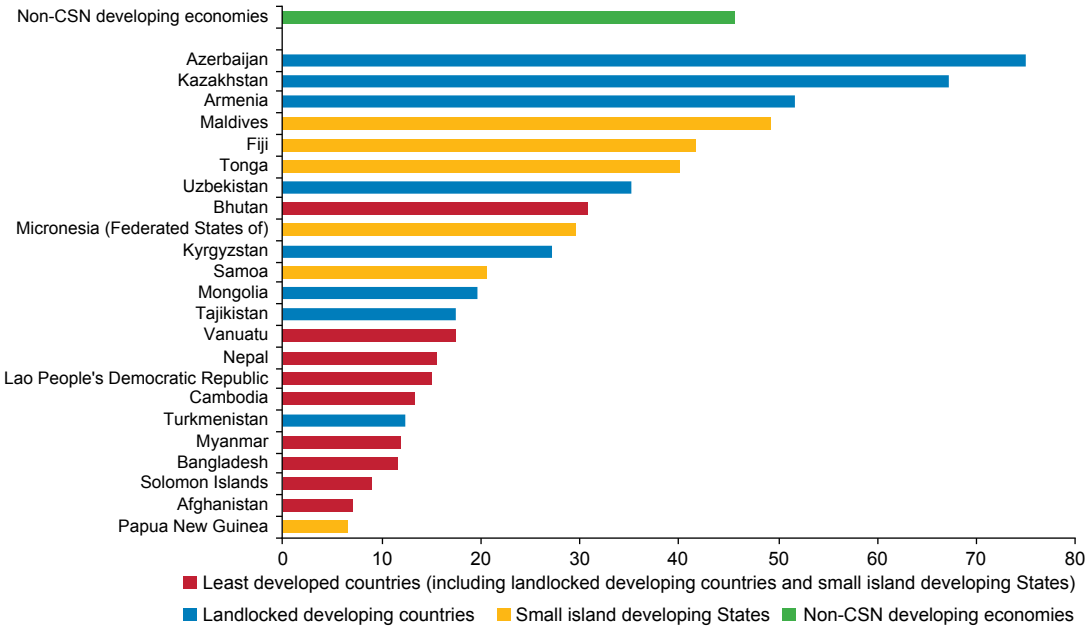
Figure 1.10. Telephone communication subscriptions per 100 head of population, 2013-2015



Source: ESCAP calculations based on data from the International Telecommunications Union and World Economic Forum on Global Competitiveness Index, available at www.itu.int (accessed November 2016).

Note: Telephone communications subscriptions in this figure cover fixed and mobile telephones.

Figure 1.11. Internet users per 100 head of population, 2012-2015



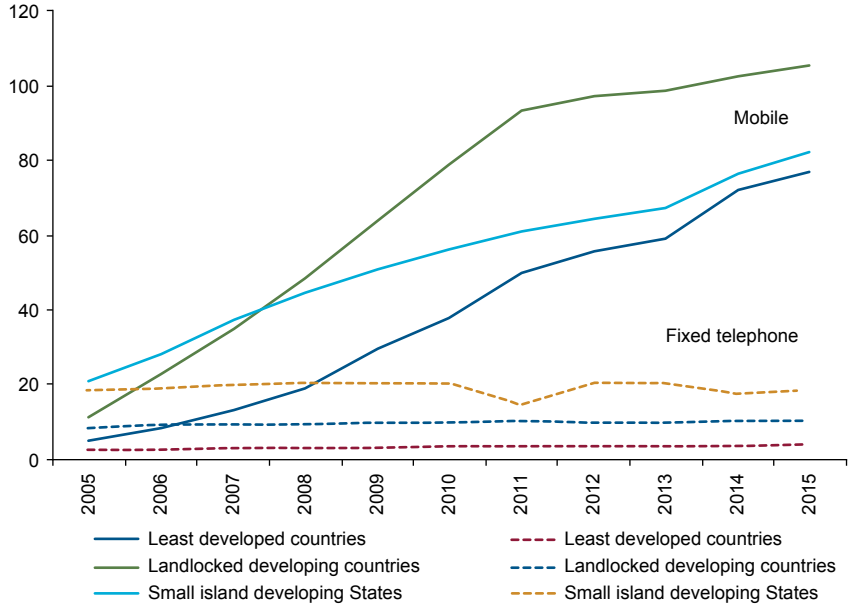
Source: ESCAP calculations based on data from International Telecommunication Union and World Economic Forum on Global Competitiveness Index, available at www.itu.int (accessed November 2016).

ICT infrastructure investment. Credible and conducive regulations towards promoting private ICT investment are also a common weakness among several CSN, especially in least developed countries.

It is interesting to note the change in composition of ICT infrastructure in CSN from 2005 to 2015. Thus, the number of fixed-line telephones has remained quite constant during the past decade, while the number of users has increased dramatically in all three groups of countries in the Asia-Pacific region (figure 1.12).

While mobile telephones may be a substitute for fixed lines, the low rate of fixed lines is, however, having an

Figure 1.12. Subscriptions per 100 head of population for fixed, mobile-cellular and fixed-broadband telephone services, 2005-2015



Source: ESCAP calculations based on ESCAP statistical database, available at www.unescap.org/stat/data/statdb/DataExplorer.aspx (accessed 10 February 2017).

impact on the availability of broadband subscriptions to the Internet. As a result, there is quite high disparity in broadband connectivity within the Asia-Pacific region (see box 1.2).

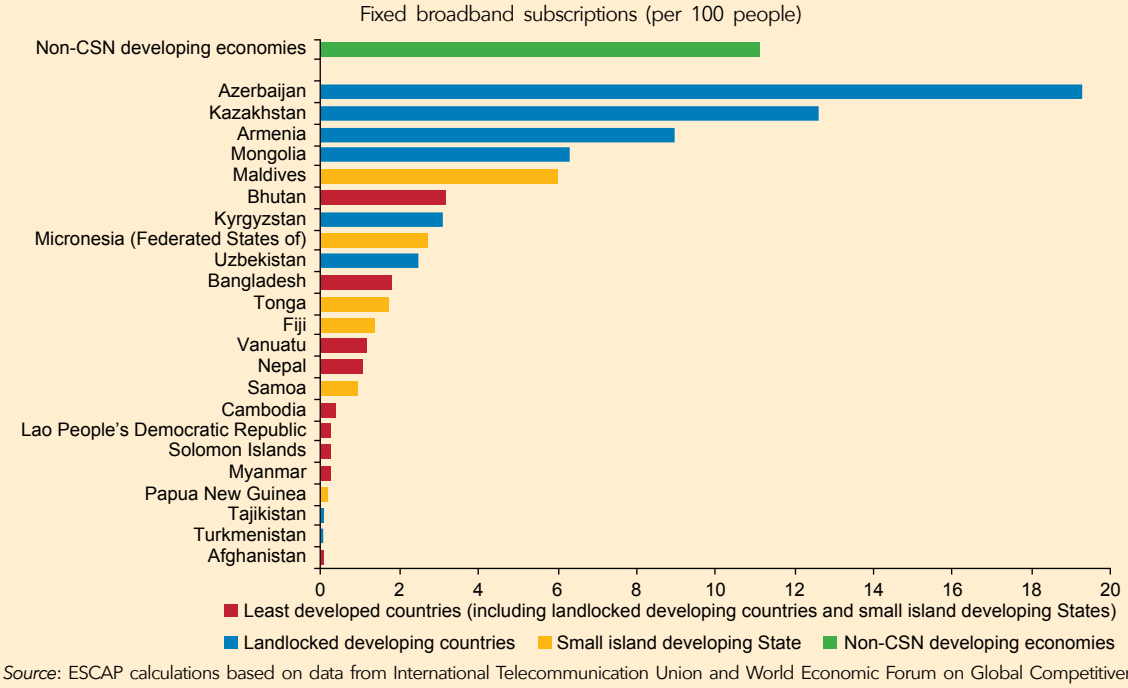
D. WATER SUPPLY AND SANITATION

Water supply and sanitation (WSS) infrastructure is required for people to be able to access clean water and safely dispose of waste. While countries have little control over the natural availability of water, infrastructure and institutions can help to ensure that this (sometimes scarce) resource is used efficiently, effectively and conservatively. Access to WSS differs widely among countries, with some countries benefiting from much better WSS services than other countries (figure 1.13). Goal 6 considers clean water and sanitation, accessibility to which is crucial to improving social well-being in CSN; lack of access to WSS leads to negative impacts, including economic loss and health problems. For example, the total global economic loss associated with inadequate water supply and sanitation has been estimated at $260 billion annually (Hutton, 2012). In Bangladesh, an estimated $4.2 billion is lost annually due to inadequate sanitation – equivalent to 6.3 per cent of the country's GDP (World Bank, 2007).

Box 1.2. Fixed-broadband subscriptions in country with special needs

The Asia-Pacific region has a high growth rate in access to fixed-broadband with 50 per cent of global fixed-broadband subscribers in the region, followed by Europe (23 per cent) and the Americas (23 per cent) (ESCAP, 2016b). However, there is an alarming disparity in broadband connectivity within Asia and the Pacific. In CSN there were fewer than five fixed broadband subscriptions per 100 inhabitants in 2015, compared with China – which accounts for more than 50 per cent of the total ESCAP member States' fixed-broadband access – and the Republic of Korea, where broadband penetration reached 40 per cent of the population in 2015. Mobile broadband penetration is even higher for the high-income countries (ESCAP, 2016d). Most landlocked developing countries are doing well in delivery of fixed-broadband to their subscribers, except those that are also least developed countries, such as Lao People's Democratic Republic and Nepal. Indeed, most least developed countries are at the bottom of the ranking of this category.

The number of fixed-broadband subscription is high in some countries because subscription fees are quite low. Fixed-broadband only cost 1.6 per cent of gross national income per capita in Kazakhstan and less than 5 per cent in Armenia, Azerbaijan, Bhutan and Mongolia in 2015 (ESCAP, 2014). High-speed broadband has great potential for promoting economic growth and the development of society as well as play a pivotal role in supporting many aspects of the 2030 Agenda.



Source: ESCAP calculations based on data from International Telecommunication Union and World Economic Forum on Global Competitiveness Index, available at www.itu.int (accessed November 2016).

Those economies that have the least access to water and sanitation are mostly countries with special needs. According to the *ESCAP Statistical Yearbook 2015*, rural populations have less access to improved water and sanitation sources than urban populations. While in landlocked developing countries and least developed countries more than 73 per cent of the population has access to water, only 53.7 per cent of the people of rural areas in landlocked developing countries and 56.2 per cent of rural areas in least developed countries have access.

Access to clean water supply not only has an immediate health benefit, but also frees up the time and resources spent on coping with poor water resources for other productive activities (World Bank, 2006). In contrast, water scarcity, poor water quality and inadequate sanitation have a negative impact on food security, livelihood choices and educational opportunities for poor families across the world. While, in general, improvements to the water supply infrastructure have led to the quasi-elimination of health disorders associated with pathogenic agents (such as cholera), in many countries concern is now for human exposure to lead in drinking water, mainly resulting from lead pipes and solder used on copper pipes.

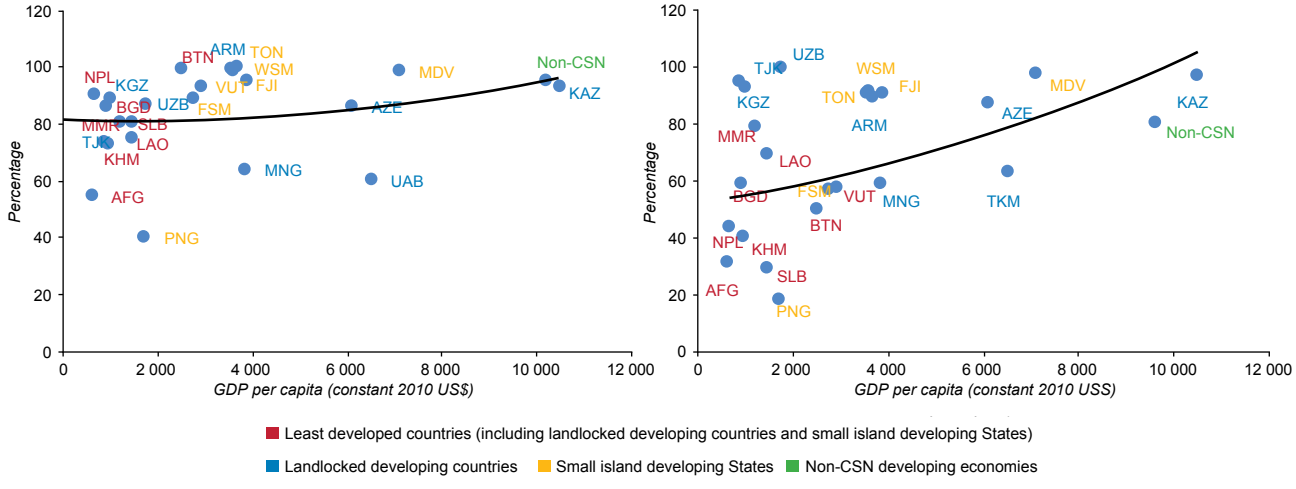
Accessibility of improved WSS can also be compared to a country's level of development, measured, for example, by income per capita. Relative to their level of income, some countries, such as Mongolia, Afghanistan and Papua New Guinea, perform relatively poorly in providing access to improved WSS, while others, such as Bangladesh, Bhutan and Armenia, perform relatively well. GDP per capita is positively associated with access to water (left-hand panel of figure 1.13), although the correlation between GDP per capita and access to improved sanitation is stronger (right-hand panel of figure 1.13).

In many CSN in the Asia-Pacific region, rapid urbanization is placing an increasing strain on infrastructure and is contributing to increasing demand for basic services. This is a particularly pressing issue in what is regarded as urban sanitation, as in many countries most households and buildings are not connected to any kind of sanitation system but instead depend on on-site technologies such as septic tanks and pit latrines. However, at present, there is no formal and environmentally sound system for faecal sludge collection and treatment. Thus, untreated effluents are usually discharged into lakes, rivers and canals, causing pollution and health hazards. While sanitation falls under the responsibility of municipalities, these often lack the necessary funds as well as organizational and technical capabilities to take up the role. In particular, municipalities often have only limited revenue for such type of infrastructure and services, making full cost recovery a real challenge.

Access to improved water and sanitation is usually more restricted in rural than in urban areas. While, on average, 90 per cent of the population between 2013 and 2015 had access to improved water supply in urban areas of CSN, significantly the average access rates in rural areas were relatively lower in rural areas in least developed countries (75 per cent), landlocked developing countries (77 per cent) and small island developing States (89 per cent) (figure 1.14).

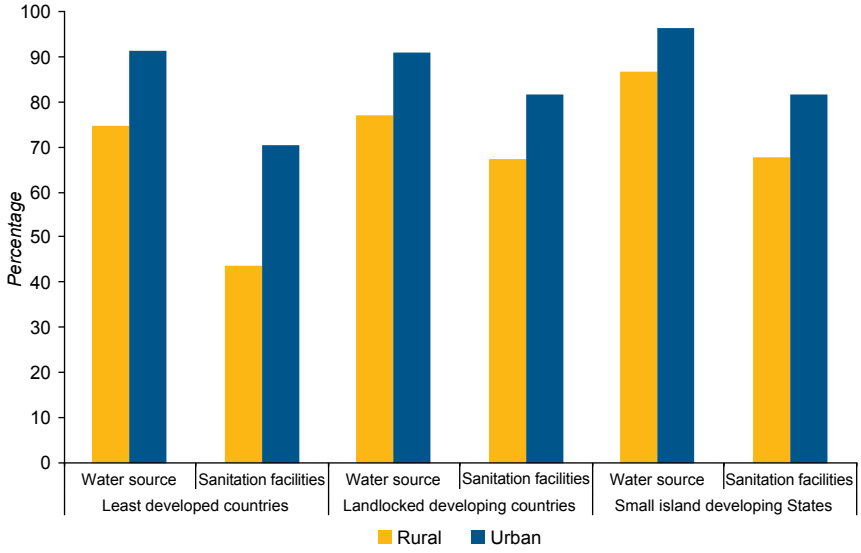
While some CSN have good infrastructure for water supply (for example, Armenia and Bhutan have universal

Figure 1.13. Access to improved water supply (left) and sanitation (right) and GDP per capita



Source: ESCAP calculations based on the World Bank database, available at http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (accessed November 2016).

Figure 1.14. Access to improved water sources and sanitation facilities in countries with special needs (rural vs. urban), 2011-2015



Source: ESCAP calculations based on data from World Development Indicator, WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation, available at www.wssinfo.org (accessed 25 Jan 2017).

access to improved water resources), the majority of these countries face issues with infrastructure. Figure 1.14 shows the percentage of total population with access to improved sanitation and improved water resources in least developed countries, landlocked developing countries and small island developing States. The percentage of access to improved sanitation is lower than the percentage of access to improved water resources.

E. NATIONAL DEVELOPMENT PLANS AND INFRASTRUCTURE POLICIES

The Asia-Pacific CSN constitute a set of diverse economies with very diverse development priorities and infrastructure needs, as the analysis in the section above has highlighted. To understand the different priorities that CSN have, this section provides a comparative analysis of national infrastructure policies, highlighting the main priorities. Doing so sheds light on the need for integrated policymaking that combines economic, social and environmental dimensions and embeds infrastructure investment plans within national sustainable development strategies. This includes policy measures to strengthen institutional capacities by highlighting risk-return informed investment projects. Within the context of an integrated approach, infrastructure-related policymaking in CSN may also determine appropriate financing options for building resilient, sustainable and inclusive infrastructure.

For example, building a stable energy supply system is vital to least developed countries to be able to expand their productive capacities and facilitate industrial development to increase productivity in their mostly labour-intensive production processes. A stable energy supply will also have significant benefits in terms of improving the quality of life. In turn, WSS infrastructure can generate significant benefits for least developed countries, particularly in rural areas, and for non-wealthy households, as access to clean drinking water and sanitation reduces health risks and frees time for education and other productive activities. It also contributes to higher productivity of the labour force. For landlocked developing countries where physical transport infrastructure remains inadequate and of poor quality, better transport connectivity that addresses missing links and bottlenecks for export diversification is necessary to secure sustained economic growth that delivers decent jobs and enables progress towards poverty eradication and broad-based sustainable development. For small island developing States, modern and accessible ICT would provide infrastructure for creating a knowledge economy to function efficiently, enabling them to overcome barriers of distance and related socio-economic disadvantages. As infrastructure gaps in traditional infrastructure are high in small island developing States, ICT infrastructure can be particularly cost-effective and provide high marginal returns on investment, thus creating momentum for economic development in services sectors as well as spillovers to other sectors.

1. Major issues and challenges

Focusing on physical infrastructure, comprising transport, energy, water supply and sanitation, and ICT, table 1.1 highlights major issues and challenges that CSN face. A review of the national development plans of CSN reveals that, in general, high priority is given to rural development, particularly in terms of improved access to electricity and improved water supply. Most least developed countries have elaborated national goals and general strategies within their national development plans for improving these selected infrastructure sectors. They also recognize that private sector engagement in infrastructure development is important, particularly in the transport and energy sector. However, in most cases, road maps or implementation strategies have not been clearly defined, and monitoring and evaluation of indicators has not been specified. There is also very limited information on ICT infrastructure and indicators related to its development in least developed countries and landlocked developing countries.

2. Least developed countries

In general, national development plans of least developed countries recognize the need for financial and technical support to develop productive capacities in line with national priorities. They also provide information on goals for new infrastructure development and maintenance of existing ones, which are strategically important for supporting regional connectivity.

Development and maintenance of transport infrastructure is the main priority in least developed countries. In the Lao People's Democratic Republic, the development plan focuses on construction and repair of roads and road maintenance. The country's urban planning envisages extensive involvement of the private sector in public transport. In Cambodia, rural development is a priority, particularly in terms of maintaining transport networks. While Myanmar has developed urban transportation systems and upgraded national airports, it is planned to improve the quality of the railroads and strengthen regional connectivity (Chaisrisawatsuk, 2017). Afghanistan has also formulated plans for an integrated transportation network as well as a system for road maintenance and rehabilitation. In Solomon Islands, the Government has indicated its commitment to rehabilitating and building new infrastructure, while in Tuvalu poor transport systems, high costs, inefficient utilities and poor maintenance of infrastructure are a priority in the country's national development plan. In Nepal, substantial national and regional efforts are emphasized for developing quality, reliable, sustainable and resilient infrastructure, including regional and trans-border infrastructure, to support economic development and human wellbeing.

In addition to the transport infrastructure in terms of priorities, energy infrastructure comes second due to the fact that there is a wide gap in access to electricity between rural and urban areas. Rural development and involvement of the private sector is a priority in all national development plans of least developed countries, particularly with regard to the provision of electricity. Indeed, most least developed countries have clearly defined the existing situation and indicators for their own rural areas and populations. In Afghanistan, as a conflict-affected country, developing electricity distribution and engaging the private sector in expediting power generation and distribution projects in urban centres as well as rural areas is given the highest priority. In Bhutan, the Government has set a goal of providing access to electricity for 75 per cent of the rural population by 2020. In Bangladesh, the Government has outlined several priorities for improving access to electricity and energy, with the focus and emphasis on rural development and the possibility of establishing private electricity distribution companies. Because of this priority, most least developed countries now intend to pay special attention to renewable sources of energy, especially solar and hydropower for generating electricity. For example, in Nepal, where 76 per cent of the population has access to electricity, achieving the energy goal will be contingent on how rapidly hydroelectricity generation can be increased. This will determine the energy mix and access to renewable energy.

3. Landlocked developing countries

Most Governments in landlocked developing countries are facing enormous difficulties for funding infrastructure development and maintenance of existing infrastructure. This is especially important when considering the key role of some of those countries in regional transit systems, including Azerbaijan, Kazakhstan and Mongolia.

In terms of main priorities in national plans that focus on infrastructure development and maintenance, landlocked developing countries mainly focus on regional corridors and integration, for which transport infrastructure tops the list of priorities followed by the energy sector and the ICT infrastructure to a certain degree, although most landlocked developing countries are performing well. Azerbaijan, for example, plans to build, reconstruct and modernize systems for transportation in order to turn the country into a regional trade hub and make effective use of the country's strategic geographical position by developing transit and transport services, and by forming

Table 1.1. Summary of major issues and challenges for different types of infrastructure

	Transport	Energy	ICT	WSS
Least developed countries	- Demand for transport infrastructure is increasing due to rapid urbanization and population growth - Quality of transport infrastructure is low - Connectivity with neighbouring countries is weak - Underdeveloped rail and road network	- Electricity provision is in poor condition - Relatively a large proportion of population still relies on traditional biomass and coal for cooking and heating - Development of alternative sources of energy needs major support - Private sector participation is low in electric power and distribution sector - International cooperation and development partnership should be strengthened	- Cost-effective use of ICT - Spillover effects on development of other infrastructure - Rate of fixed broadband subscription is low - Investments more associated with fixed and mobile broadband are needed. - High potential for creation of knowledge economy	- WSS infrastructure needs improvement for social development - Provision of safe drinking water and proper sanitation is in poor condition
Landlocked developing countries	- Remoteness - Transit systems need improvement - Quality of roads is low due to lack of maintenance - Regional integration/ cooperation should be strengthened	- Provision of electricity needs further improvement - High potential sources of renewable energies, mainly hydropower and solar energy	- High potential for creation of knowledge economy - Cost-effective use of ICT - Spillover effects on development of other infrastructure	- Provision of water supply and sanitation needs further improvement in some landlocked developing countries
Small island developing States	- Demands for transport infrastructure is increasing due to rapid urbanization and population growth - Maritime and air transport systems need further development - Facilities are susceptible to natural disasters - Financial resources are very limited, which affects both infrastructure investment and maintenance - Remoteness causes significant impact on transport systems development - Transport infrastructure should be improved to develop tourism sector	- Provision of electricity is inadequate - Development of renewable energy sources need support - Rural electrification is low - Fossil fuel consumption is high - Funding is limited - Energy efficiency practices should be further promoted - Susceptible to natural disasters - Investment opportunities for PPP are small - The involvement of community	- Improvement of access to mobile phones is sluggish - Facilities are susceptible to natural disasters - High potential for creation of knowledge economy - Cost-effective use of ICT - Spillover effects on development of other infrastructure - Growing private sector investment - Virtual connectivity should be promoted - Resilient ICT infrastructure is important - Potential for wider use in disaster risk management, and post-disaster recovery	- Provision of proper sanitation facilities needs improvement - Facilities are susceptible to natural disasters - Natural storage of clean water is limited

Source: National Development Plans.

logistical centres within the country. In Kyrgyzstan, the main priority is to meet people's needs for passenger and freight transport by upgrading and renewing vehicle fleets and developing and diversifying transport routes including air, railways and roads. Tajikistan's national plan identifies steps to lower political and institutional barriers to regional cooperation related to transport infrastructure.

The landlocked developing countries in the Central Asian region have focused mainly on programmes for railway infrastructure capacity development. For example, Kazakhstan has formulated a plan to modernize its main railroad routes; in Kyrgyzstan, construction is planned of a China-Kyrgyzstan-Uzbekistan railway as well as another rail route that will connect the country's north and south; in Turkmenistan, a new railway line for internal and international communications is planned. Landlocked developing countries such as Azerbaijan, the Lao PDR, Kazakhstan and Mongolia also plan to improve existing airports to meet international standards. Some other landlocked developing countries such as Armenia, Bhutan and Nepal have identified the need to reconstruct airports mainly to develop the tourism industry.

In the case of energy infrastructure at the regional level, ESCAP intergovernmental processes are focusing on cross-sectoral synergies among transport, energy and ICT as well as the development of an "Asian Energy Highway" of oil and gas pipelines and grid connections across borders to reinforce the integration of landlocked developing countries. Resource-rich landlocked developing countries play a major role in this type of infrastructure in the region. At the same time, the share of renewable energy in electricity generation is already quite remarkable in several landlocked developing countries. Kazakhstan has significant potential for utilizing solar and wind energy, while also possessing vast deposits of natural and energy resources; its territory has oil and gas fields, ranking it among the top 10 oil-extracting nations. Turkmenistan foresees a high level of investment in fuel and energy as well as reconstruction of existing and construction of new electric stations. Uzbekistan also plans to modernize its low-voltage electricity networks, transformers and sub-stations, and to replace high energy-consuming and ineffective heating boilers with energy-saving ones. The performance of Azerbaijan in ICT, particularly in Internet development, is remarkable among the other countries in this group, as the country has established some measures for developing the space industry and aims to join the group of countries that have their own satellites.

4. Small island developing States

Several Pacific small island developing States are exposed to potentially devastating natural disasters, such as earthquakes, cyclones and tsunamis, affecting their infrastructure. Infrastructure development in these countries therefore needs to take quality, environmental related concerns into account to make it more resilient to natural disasters and climate change. Overcoming the challenge of having very limited financial resources is a key challenge for rehabilitating and maintaining infrastructure and public facilities in this group of island countries.

Considering the remoteness of small island developing States, ICT infrastructure development has been identified as one of the critical issues they face; as a result, many of them have formulated plans for expanding access to ICT services. Among the small island developing States, Guam possesses the most advanced telecommunications infrastructure and systems in the western Pacific region, as the island sits at the nexus of the Pacific's underwater fibre-optic cabling network with more terminating cable connections than anywhere else in the world. This makes Guam a telecommunications hub for numerous international providers. There has also been remarkable progress in Fiji to the extent that in 2011, the International Telecommunication Union assessed Fiji's ability to deliver ICT services and infrastructure to its citizens as among the highest in the world. In contrast, Kiribati is one of the least "connected" countries in the world, as the majority of the population either has no access to ICT or is unable to afford the service. However, recent deregulation and privatization of the national telecommunications enterprise (to Fiji's Amalgamated Telecom Holdings) is expected to result in network investments to improve coverage and affordability. In Marshall Islands, there is no telephone network in the outer islands. In Nauru, the levels of access to broadband Internet services are low; however, the country is launching a joint venture for the provision of telecommunication services as a unique model within the Pacific region. Samoa is focusing on universal access to reliable and affordable ICT Services.

However, further competition and investment in infrastructure will raise affordability. In Papua New Guinea, the Government's objective under its ICT policy is to provide cost- efficient, reliable and effective ICT services through the development of ICT infrastructure in the public and private sectors. In Solomon Islands, an uncompetitive ICT market situation has resulted in low investment in network, low-quality services and relatively higher costs. However, ICT connections in many small island developing States, particularly to reliable broadband, remain poor.

There is a large role that the private sector can play in providing access to ICT, as highlighted in the strategic development plans of these countries, and facilitation of broader benefits accompanying regulatory frameworks for pricing, access, consumer protection and competition is needed.

The major challenges for most small island developing States is the sustainable provision of adequate supplies of clean freshwater and wastewater disposal, which requires improved resources management, efficient service providers, and better local and national water governance; this is reflected in many of small island developing States national development plans as the highest priority. Access to improved water supply and sanitation is particularly important in the small island least developed countries. Thus, Kiribati's national development strategy highlights a number of infrastructure specific strategies for supporting development in six key development areas. Improved infrastructure is one of the underlying areas of priority of national policies and strategies, including rural development and the quality and quantity of safe water supply, with special focus on renewable sources of energy.

Solomon Islands is another example of the focus of small island least developed countries on rural development. The country has outlined a number of priorities, among which rural development is considered to be particularly important, as is the improvement of water supply and sanitation. Cook Islands considers improved access to sufficient and safe water as of the country's highest priority, which is also reflected in the country's recent significant investment in water infrastructure. The water supply system in Palau has been much improved, and although lines have been extended more are needed for full coverage. The Government of Samoa has prioritized the conservation and rehabilitation of key catchment areas through the implementation of the Water Resource Management Bill, which mandates the Government to secure the conservation, maintenance and sustainable use of all water resources. Overall water infrastructure in Solomon Islands is rundown and needs substantial investment for urgent upgrade, rehabilitation and maintenance. In Marshall Islands, piped water is not available in almost all the outer islands, and water supply is often lacking in urban areas due to the outdated infrastructure.

Although development and maintenance of transport and energy infrastructure may not be considered as immediate priorities by the small island developing States, the conditions in these countries should not be neglected. In particular, infrastructure is a priority for all Pacific small island developing States. In Marshall Islands, sea and air transport to outer islands are still inadequate and most runways are not paved. Fiji has outsourced road infrastructure maintenance and development, while the Fiji Roads Authority project manages, plans and prioritize investments. Roads in Solomon Islands have deteriorated due to the lack of maintenance as well as destruction during ethnic tension and natural disasters; however, a new programme of labour-based community contracts is improving the status of roads, although it is only a partial solution for selected areas. In Papua New Guinea, progress in providing electricity to rural areas has been slow, exacerbated by inadequate maintenance of existing infrastructure. Solomon Islands has challenging conditions for sustainable energy development due to the widely-scattered market on islands that are separated by large areas of sea and which have small, isolated communities.

F. PRIORITIZING AND SEQUENCING INFRASTRUCTURE DEVELOPMENT

Three important challenges stand out among those that policymakers in the CSN face in developing their infrastructure, i.e., prioritization, sequencing and financing. Financing infrastructure development is particularly challenging in the CSN, an issue to which chapter 3 in this report is devoted. This section therefore focuses on prioritization and sequencing.

1. Prioritization

Prioritizing infrastructure development and maintenance depends on the combination of the three interlinked factors: (a) the current state of existing infrastructure; (b) challenges in developing and maintaining infrastructure (based on internal or external factors); and (c) where a country's priorities lie. This, in turn, is influenced by national plans or national/regional initiatives. For example, for the group of countries with special needs as a whole, section E.1 above suggests that transport infrastructure should be given the highest priority as its availability is the most limited, with road and rail line density being less than half the average of other developing countries in the region.

Whether or not physical infrastructure is developed in sectors where access is the weakest also depends on perceptions of infrastructure development needs in countries with special needs. If the perceived needs coincide with the existing gaps, it is more likely that

development will take place in that sector. In this regard, a survey was undertaken of relevant experts in countries with special needs in the region to reveal perceived gaps in infrastructure. Its findings indicate that stakeholders indeed perceive that transport infrastructure is the least improved in least developed countries and landlocked developing countries, while water supply and sanitation infrastructure is the least developed in small island developing States and therefore requires the most attention.[6]

Furthermore, least developed countries and landlocked developing countries believe that they are facing significant challenges in energy infrastructure development and maintenance, while small island developing States see transport infrastructure development and maintenance as the most challenging for them even though the national development plans of small island developing States emphasize the development of ICT infrastructure. This is partly due to the fact that ICT is a cross-cutting enabler for other types of infrastructure such financial, trade and transport facilitation infrastructure as well as innovations. In considering priority of infrastructure development and maintenance itself, least developed countries and small island developing States believe that a very high priority should be given to the transport infrastructure development, followed by energy for least developed countries and WSS for small island developing States. However, landlocked developing countries view the energy as very high priority, followed by transport as a high-priority.

In terms of prioritization of infrastructure development and maintenance as a whole, all CSNs consider the development of transport infrastructure as the highest among all sectors, based on the three factors of current status, challenges and the priority, while ICT infrastructure has the lowest priority. Least developed countries and landlocked developing countries consider energy infrastructure as the second highest in priority, while WSS and ICT infrastructure is seen as needing to be prioritized in small island developing States.

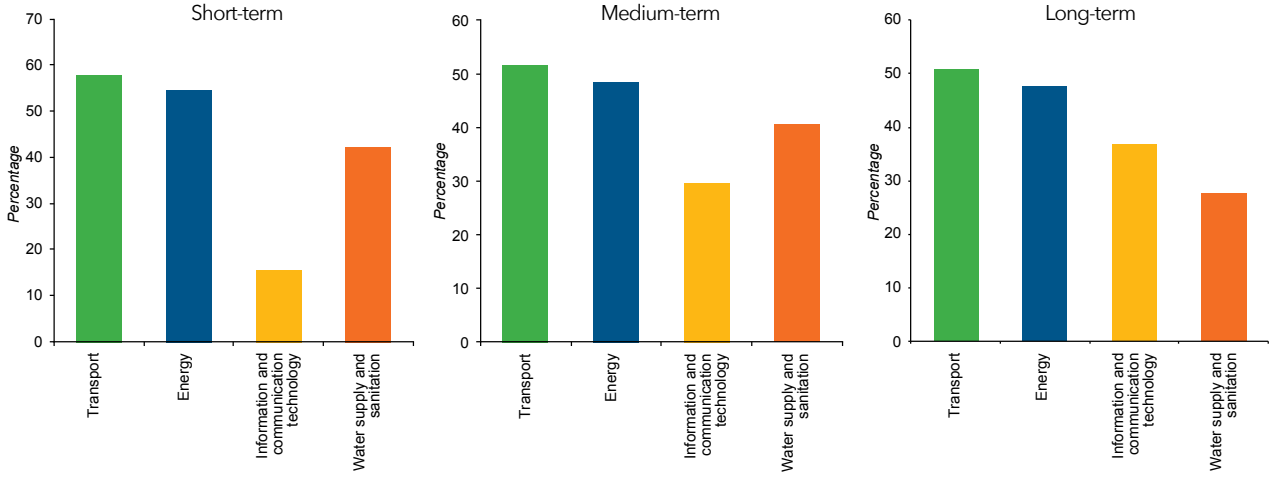
2. Sequencing

In addition to prioritizing infrastructure development and maintenance, sequencing is especially critical given that the CSN face the challenges created by limited resources. In this regard, the level of urgency for development and maintenance among the four sectors of infrastructure covered by this study has been considered as short term (within one year), medium term (within five years) or long term (more than five years).

In line with prioritization, transport infrastructure is considered to be the most important and urgent area for improvement followed by energy infrastructure, while ICT infrastructure is considered the least urgent of the four sectors (figure 1.15). This is partly due to the fact that the ICT infrastructure has been growing rapidly in recent years in the CSN, particularly in the least developed countries; thus, no major attention is currently needed. In addition, the private sector plays a major role in development and maintenance of ICT infrastructure while other sectors need the involvement of both the public and the private sectors due the nature of the requirements. WSS has been considered as important in sequencing after transport and energy infrastructure in the short and medium term but last in sequencing in the longer term.

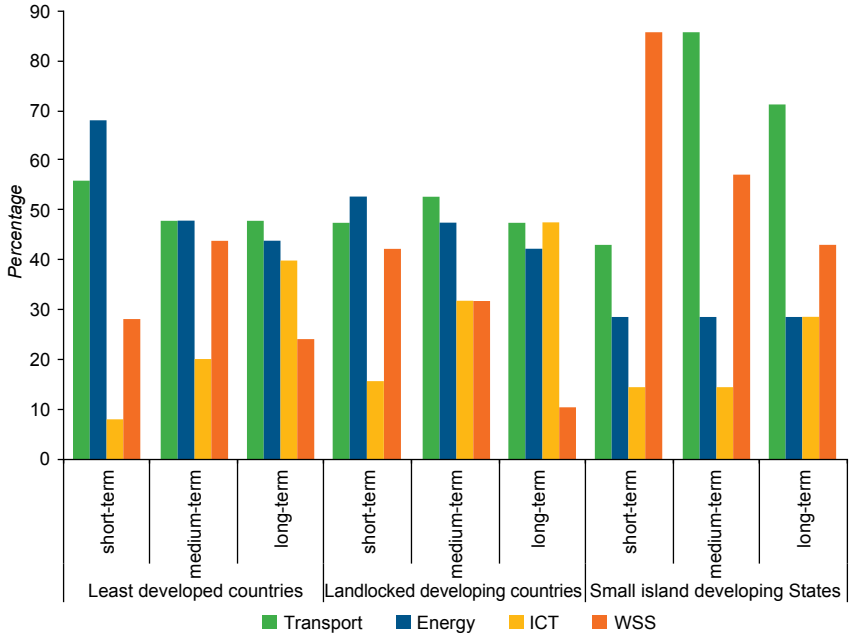
However, analysis across the CSN grouping reveals a slightly different picture. For least developed countries and landlocked developing countries energy infrastructure

Figure 1.15. Sequencing of infrastructure development and maintenance in countries with special needs



Source: ESCAP summary of experts' views on challenges and opportunities for infrastructure development and maintenance in Asia-Pacific CSN, circulated from 30 November 2016 to 9 February 2017.

Figure 1.16. Sequencing of infrastructure development and maintenance in least developed countries, landlocked developing countries and small island developing States

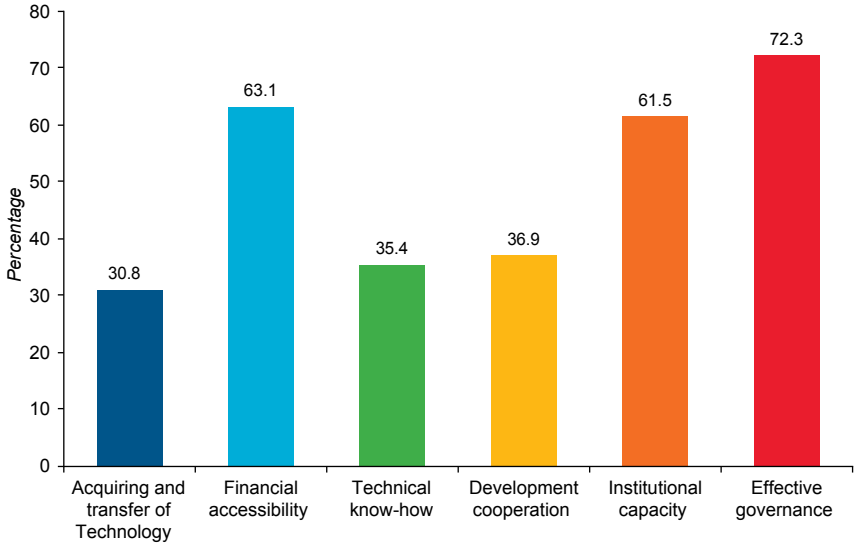


Source: ESCAP summary of experts' views on challenges and opportunities for infrastructure development and maintenance in Asia-Pacific CSN, circulated from 30 November 2016 to 9 February 2017.

improvement is considered to be the most urgently needed, while WSS infrastructure development is the most urgent in small island developing States (figure 1.16), shifting the priority for transport infrastructure to the medium and long term. Again, in all cases, ICT infrastructure is considered the least important sector of all four considered in this report.

The three most relevant challenges for infrastructure development and maintenance in the CSN are effective governance (71.2 per cent), financial accessibility (63.5 per cent) and institutional capacity (63.5 per cent). Acquiring and the transfer of technology (30.8 per cent) is the least challenging (figure 1.17).

Figure 1.17. Most relevant challenges for infrastructure development and maintenance



Source: ESCAP summary of experts' views on challenges and opportunities for infrastructure development and maintenance in Asia-Pacific CSN, circulated from 30 November 2016 to 9 February 2017.

G. CONCLUDING REMARKS

This chapter has shown that infrastructure is a multidimensional concept and that the overall state of physical infrastructure is unsatisfactory in many CSN. This is particularly the case in least developed countries and small island developing States, where transport infrastructure is of poor quality and the proportion of the population with access to energy, ICT and WSS facilities is quite low. The four sectors of infrastructure are largely identified to be poor or only adequate while the transport sector is of particular concern. In contrast, infrastructure development and maintenance is in a better state in most landlocked developing countries, which outperform most other CSN. However, there too, the transport sector needs proper maintenance and further development. In the small island developing States, few roads are paved and mobile penetration can be low, while the level of provision of energy and WSS services varies between countries that have fewer dispersed islands and archipelagos – with inhabitants of the latter countries generally having much greater limited access to electricity and WSS facilities in contrast to those of the former.

While transport sector development and maintenance is challenging for the least developed countries, improving transport infrastructure is given the highest priority in those countries as that enables them to lower trade costs, and to develop value chains and structurally transform their economies. The energy sector is given similar degrees of priority since it, too, is critical to enabling least developed countries to expand their productive capacities. For landlocked developing countries, a higher priority is given to the energy sector than to transport, which is largely unexpected. However, none of the sectors are identified to be particularly challenging for landlocked developing countries.

This chapter has analysed national development plans of countries with special needs in the region, arguing that those of the small island developing States point to the importance of developing ICT infrastructure in order to overcome the barrier of distance. However, this is not something that these countries appear to confirm when looking at their national development plans. The aggregate analysis shows that developing the transport sector should be prioritized in the least developed countries and landlocked developing countries, followed by the energy sector. While developing the WSS and ICT sectors is a relatively less pressing need in these countries, it is highly emphasized in small island developing States. Based on the composite index and national development plans, the small island developing States should accelerate the development of ICT infrastructure, while expanding access for the rural population to advanced energy sources and WSS facilities is also required. Finally, this chapter discusses the need to prioritize and sequence infrastructure development in the CSN.

ENDNOTES

1 The Asian Highway classification and design standards provide minimum standards and guidelines for the construction, improvement, and maintenance of Asian Highway routes. For example, Class I: number of lanes (4 or more) and width of lanes is 3.50 meters.

2 The 'missing link' is the absence of physical linkages between the railway networks of neighbouring countries or an absence of continuous railway infrastructure within one country due to local geography.

3 See http://www.unescap.org/news/intergovernmental-agreement-dry-ports-comes-force.

4 This section focuses on generating electricity from secondary energy, while other ways of using energy (i.e., energy efficiency improvement in end use sectors such as the industry, building, and transport sectors; transport fuels) are not included in the discussion.

5 United Nations Statistics Division, 2016, SDG Indicators Global Database. Available at https://unstats.un.org/sdgs/indicators/database/.

6 To understand the challenges and opportunities that countries in the region face in developing and maintaining their infrastructure, ESCAP conducted a survey among policymakers, infrastructure or sectoral experts, and representatives of the private sector and the civil society organizations of the CSN and other member States in the region. Thirty-eight per cent of the responses to the questionnaire were from research institutes and academia, 27 per cent from civil society organizations and non-governmental organizations, 15 per cent from the private sector and 11 per cent from the Governments.

CHAPTER 2
ESCAP ACCESS TO PHYSICAL INFRASTRUCTURE INDEX

The multidimensional character of infrastructure makes comparison of infrastructure development across countries and time difficult. Nevertheless, to be able to quantitatively assess how physical infrastructure has improved in the region over the past decade, and to be able to compare how CSN perform relative to each other and to other developing countries in the region, this chapter presents a composite index, the ESCAP Access to Physical Infrastructure Index (APII). The index provides a quantitative assessment of the four sectors of physical infrastructure that have been highlighted as relevant to CSN in their respective programmes of action by capturing transport, energy, ICT and water supply and sanitation-related indicators. The composite index is aimed at highlighting the performance of CSN in these sectors and is intended to be used as a policy tool to help formulate infrastructure development policies that can support the implementation of sustainable development (Basu, 2017).

The APII can be split into four individual sub-indices: (a) transport, which captures access to road and railways; (b) energy, which captures access to electricity and power consumption; (c) information and communications technology (ICT), which captures access Internet services, and mobile and fixed lines; and (d) water supply and sanitation (WSS), which captures access to drinking water and sanitation (details of indicators are provided in annex II).

The four dimensions of the APII are measured to gain the composite measure of physical infrastructure performance. Each of the dimensions is composed of two indicators that highlight access to physical infrastructure in the relevant dimension, such that a total of eight indicators are captured by the APII. The choice of these indicators is based on their theoretical background and data availability for the majority of the least developed countries, landlocked developing countries and small island developing States. In order to increase coverage of countries and data, indicators were constructed on a three-year average; for example, for the latest year, the index covers the period between 2013 and 2015. Furthermore, the index is based on the scoring methods of these four dimensions by simple average (equal weights), and each of the four sectoral indices are based on the standardized indicators that is a combination of two indicators for each of the sectors (annex III).

Importantly, the measurement of physical infrastructure captures access indicators as opposed to process indicators, such as policies, and rules and regulations. In doing so, the composite index can be linked to targets of the Sustainable Development Goals, such as: (a) increasing employment opportunities and average real wages; (b) improving health and education outcomes; and (c) preserving environmental sustainability. Pursuing robust and forward-looking infrastructure development policies will thus help CSN in achieving the 2030 Agenda for Sustainable Development targets.

The APII has been computed for 41 countries in the Asia-Pacific region, of which 23 are CSN, 15 are other developing countries in the region and three are the developed countries from the region (Australia, Japan and New Zealand). These 41 countries account for 98% of the region's population and 95% of its GDP. Moreover, the score of developed countries serves as a long-term benchmark of CSN to be achieved by 2030, while the average score for the 15 developing countries serves as the medium-term benchmark to be achieved between 2025 and 2030.

A. SELECTION OF INDICATORS

The benefits of infrastructure investment in sectors such as transport, energy, ICT and WSS can boost economic activities through increased productivity as well as the promotion of economic diversification and competitiveness. Strengthening connectivity promotes further backward and forward economic linkages, which are crucial for connecting domestic markets with regional production networks.

The selection of the four dimensions and related indicators are based on the following issues.

1. Transport

Transport infrastructure enables an efficient delivery of public services to populations. It also leads to better disaster risk reduction and management, in particular for least developed countries and small island developing States, as it enables access for rapid supply relief aid to affected communities. By improving transport infrastructure, countries can reduce the time that employees spend commuting to work; it also connects rural and isolated areas to domestic and regional markets. The road density (i.e., total road routes per 1,000 km^2 of land area) and the rail lines density (i.e., total rail routes per 1,000 km^2 of land area) are chosen as indicators to reflect the transport infrastructure.

2. Energy

An expansion of the electricity grid provides energy access to urban and rural areas. This is necessary for

improving productivity of the industrial sector, which currently contributes less than one-third of GDP in least developed countries and small island developing States. Access to electricity (percentage of total population) and electric power consumption (kWh per capita) are chosen as indicators to reflect the energy infrastructure.

3. Information and communications technology

The possibility of leapfrogging older technologies makes investing in ICT-related infrastructure particularly relevant, given the potential multiplier effects in economy-wide activities, especially with regard to the development of service sectors in CSN (United Nations, 2016). Thus, ICT infrastructure can facilitate trade through enhanced communication between buyers and sellers as well as reduced costs of doing business. Internet users (per 1,000 head of the population) and combined subscriptions of mobile phones and fixed telephone (per 1,000 head of the population) are chosen as indicators to reflect the energy infrastructure.

4. Water supply and sanitation

To create sustainable water supply and sanitation infrastructure, CSN need to strengthen their management of scarce resources. Moreover, this is especially the case considering strong evidence that investing in low-carbon growth can lead to greater prosperity in a sustainable manner, and given the negative impact on the environment that is associated with emissions and other types of industrial waste (ESCAP, 2016a). This type of infrastructure is expected to improve health and education outcomes. In this regard, WSS infrastructure has direct implications not only for economic aspects, but particularly for economic activities, social development and environmental sustainability. Access to improved water sources (percentage of total population) and improved sanitation facilities (percentage of total population) are chosen as indicators to reflect WSS infrastructure.

B. ACCESS TO PHYSICAL INFRASTRUCTURE INDEX: SCORES AND RANKINGS

The APII scores and corresponding ranking for the sample of 41 Asia and the Pacific countries are shown in table 2.1. The performance of countries are shown for overall infrastructure performance by combining the four sub-index results for transport, energy, ICT and WSS. The APII scores also highlight the CSN group-specific differences. The 41 Asia-Pacific countries included in the sample are grouped into countries with special needs, and developing and developed countries.

In 2013-2015, the five top-ranked countries comprised all developed countries except Singapore (ranked second) and the Republic of Korea (ranked third) (table 2.1). While three of the countries that are ranked among the top 10 include two landlocked developing countries (Azerbaijan and Kazakhstan) and a small island developing State (Maldives), those with the lowest level of infrastructure development are all CSN, with seven being least developed countries. Interestingly, the two largest developing countries in population terms, i.e., China and India, lag behind several other peers in the region. China (ranked 19) is not among the top 10 performers. India (ranked 31) is in the bottom quartile of the ranking among 41 countries.

Figure 2.1 shows the APII scores for the three CSN groups. It illustrates the fact that access to physical infrastructure is significantly less developed in least developed countries than in small island developing States and landlocked developing countries. The average scores for developed countries are much better than other country groupings. For the three CSN groups the average APII scores are also much lower than the average scores of developing countries. It is therefore evident that there are significant differences in access to physical infrastructure between developed countries and other developing countries, including the CSN.

One of the objectives of the APII is to identify policy options that may help to overcome challenges of infrastructure development. To enable benchmarking, countries are aggregated into two groups: (a) developing countries; and (b) developed countries from Asia and the Pacific. As indicated above, the long-term CSN benchmark is to reach, by 2030, the level of access to physical infrastructure that developed countries had in 2015. The medium-term benchmark for CSN to reach, between 2025 and 2030, is the level of access that developing countries in the region had in 2015. The 2015 level for the region's developed countries is 0.633, while that of developing countries was 0.431. Clearly, catching up will be a significant challenge for the least developed countries in the region.

The analysis of the APII reveals that the low scores of least developed countries are a result of low average scores in each of the four dimensions of infrastructure, i.e., transport, energy, ICT and WSS (figure 2.2). In particular, the score for the transport sector is substantially lower than that in the developing and developed countries in the sample. The performance of the energy sector is

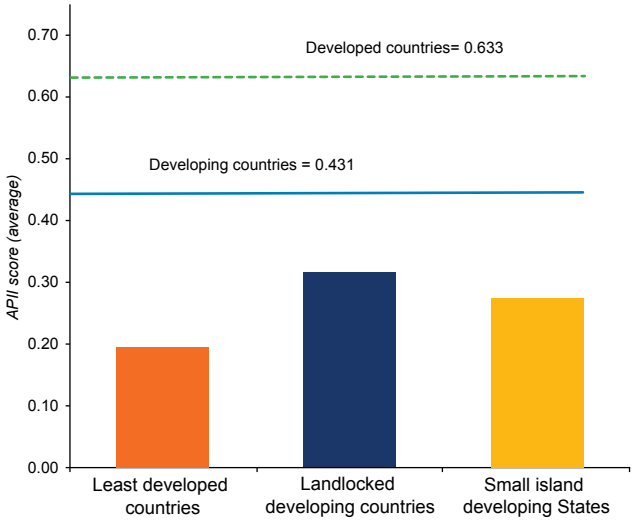
Table 2.1. Scores and rankings in the Access to Physical Infrastructure Index, selected countries in Asia and the Pacific, 2015

Country groupings	APII score	APII rank
Countries with special needs	**0.288**	
Kazakhstan	0.520	6
Azerbaijan	0.476	9
Maldives	0.463	10
Armenia	0.453	11
Fiji	0.394	17
Tonga	0.371	20
Kyrgyzstan	0.370	21
Uzbekistan	0.365	22
Samoa	0.350	23
Tajikistan	0.309	26
Bangladesh	0.277	28
Bhutan	0.269	29
Turkmenistan	0.269	29
Mongolia	0.235	32
Micronesia, Federated States of	0.232	33
Lao People's Democratic Republic	0.225	34
Nepal	0.217	35
Vanuatu	0.200	36
Myanmar	0.198	37
Cambodia	0.186	38
Solomon Islands	0.113	39
Afghanistan	0.072	40
Papua New Guinea	0.070	41
Developing countries	**0.431**	
Singapore	0.708	2
Korea, Republic of	0.664	3
Malaysia	0.502	7
Russian Federation	0.495	8
Turkey	0.440	12
Georgia	0.436	13
Viet Nam	0.419	14
Thailand	0.418	15
Sri Lanka	0.407	16
Iran, Islamic Republic of	0.394	17
China	0.391	19
Philippines	0.336	24
Pakistan	0.311	25
Indonesia	0.278	27
India	0.260	31
Developed countries	**0.633**	
Japan	0.712	1
New Zealand	0.605	4
Australia	0.582	5

Source: ESCAP.

Note: 2015 was computed from the three-year average between 2013-2015.

Figure 2.1. Access to Physical Infrastructure Index scores, 2015



Source: ESCAP.

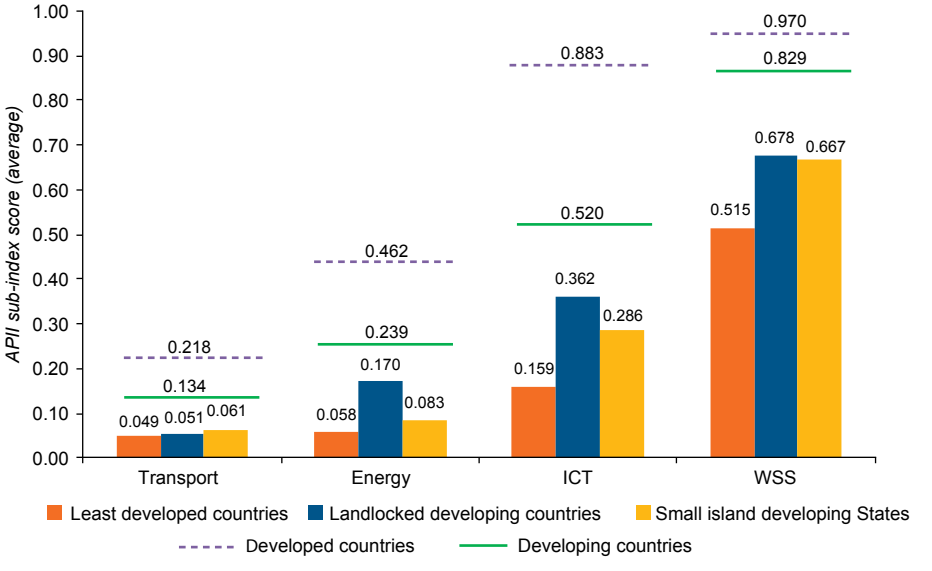
Note: The APII for 2015 was computed from the three-year averages between 2013-2015.

slightly better in the least developed countries, while the scores for ICT and WSS also lag significantly behind other developing countries and developed countries from the region. A closer look at sectoral levels indicates that the gap is large in each of these sectors in least developed countries compared with landlocked developing countries and small island developing States.

Compared to least developed countries, landlocked developing countries have a comparable score for transport infrastructure, but much better scores in the other three sectors of infrastructure. However, the scores for all the four dimensions of infrastructure are still lower than the average in developing and developed countries. The gap is large in the case of WSS facilities infrastructure. For small island developing States, the scores for transport and energy infrastructure are slightly higher with regard to least developed countries, while the ICT scores are lower than for landlocked developing countries and WSS scores are similar to the scores for landlocked developing countries.

Among the four dimensions of physical infrastructure, the infrastructure access gap is more pronounced in transport infrastructure, together with energy and ICT, while the gaps for WSS access are much smaller across least

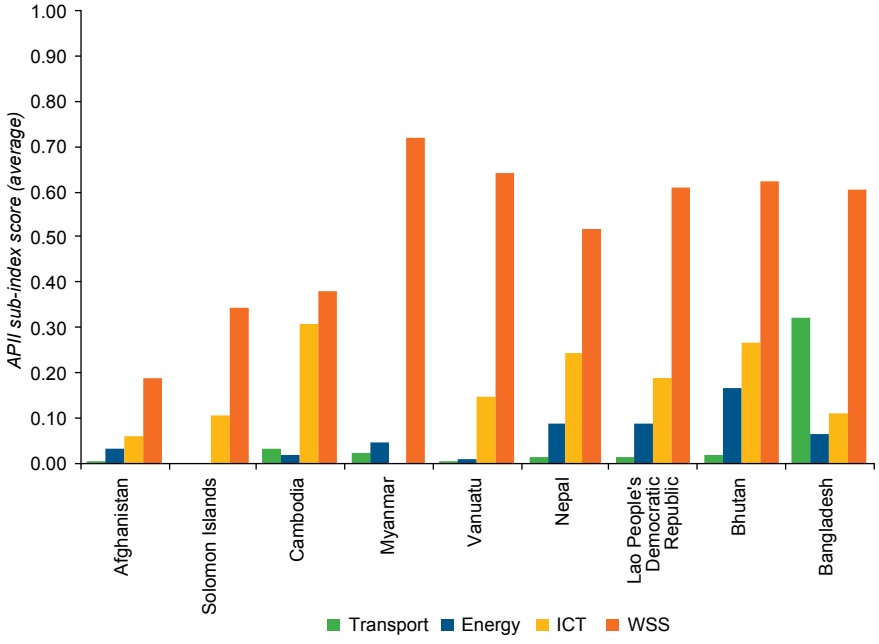
Figure 2.2. Dimensions of Access to Physical Infrastructure Index scores: A comparison among groups, 2015



Source: ESCAP.

Note: The APII for 2015 was computed from the three-year averages between 2013-2015.

Figure 2.3. Access to Physical Infrastructure Index scores in least developed countries, 2015



Source: ESCAP.

Note: The APII for 2015 was computed from the three-year averages between 2013-2015.

developed countries, landlocked developing countries and small island developing States compared with the scores for all developing and developed countries.

1. Least developed countries, landlocked developing countries and small island developing States: Scores and rankings

Within the least developed country group there are large variations (figure 2.3). An overall analysis of the four dimensions of APII shows Bangladesh ranks top, followed by Bhutan, the Lao People's Democratic Republic, and Nepal. Bangladesh's scores are higher due to a high average score for transport and WSS performance. Afghanistan is at the bottom of the least developed countries due to a lack of progress in each of the four sectors of physical infrastructure access. Myanmar has the highest score in WSS, but lags behind in other sectors.

Figure 2.4 shows the results of a comparative analysis carried out for the four sectors of infrastructure of APII for the landlocked developing country group. The analysis indicates that Kazakhstan leads the group, followed by Azerbaijan and Armenia. In all three countries, the scores across four sectors of physical infrastructure are similar. Interestingly, the energy infrastructure scores are relatively high in these countries compared with the least developed countries. The gaps between transport and energy infrastructure scores are large for Kazakhstan and Kyrgyzstan. In Armenia and Azerbaijan, the scores between transport and energy infrastructure are similar.

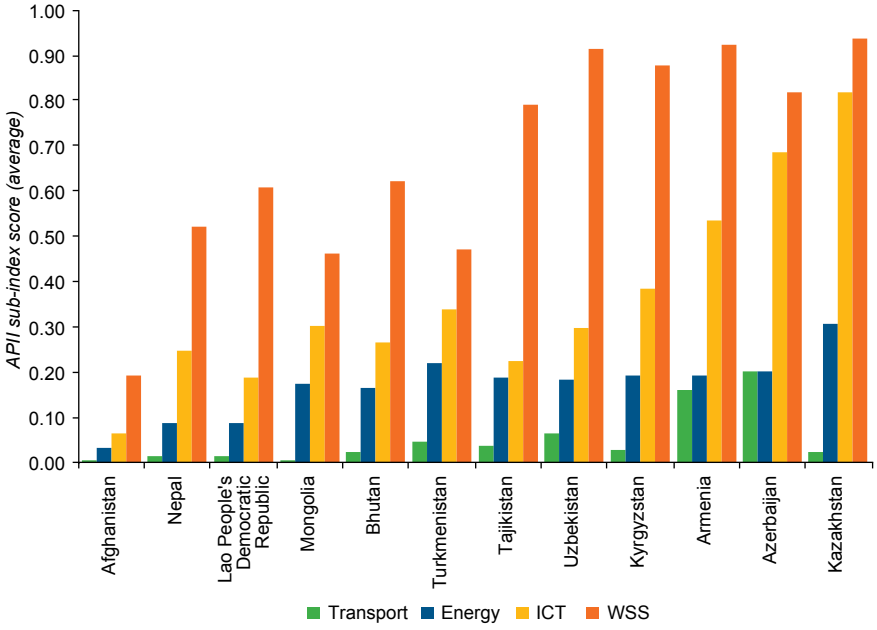
The small island developing States' scores for the four sectors of infrastructure of APII indicate that those countries are at various levels of development. Maldives has the most developed infrastructure, followed by Fiji, Tonga and Samoa (figure 2.5). Maldives scores high in energy and ICT compared with Fiji, Tonga and Samoa. On the other hand, the scores of Papua New Guinea, Solomon Islands and Vanuatu lag significantly behind in most of the sectors, while the Federated States of Micronesia and Samoa are in the middle of the small island developing States group.

The analysis of sectors highlights the fact that the CSN group scores lag significantly, especially in least developed countries. The above results indicate that countries have higher scores if they have an overall balance in most of the sectors.

2. Sectoral pattern of APII scores: A comparison, 1990 and 2015

In a further analysis of underlying differences across the CSN group, another look at the sectoral pattern reveals several important facts regarding the evolution between 1990 and 2015. The discussion below shows that APII scores can be provided for each of the four sectors, computed as sub-indexes underlying normalized indicators with equal weight for 41 countries during 1990 and 2015.

Figure 2.4. Access to Physical Infrastructure Index scores in landlocked developing countries, 2015



Source: ESCAP.

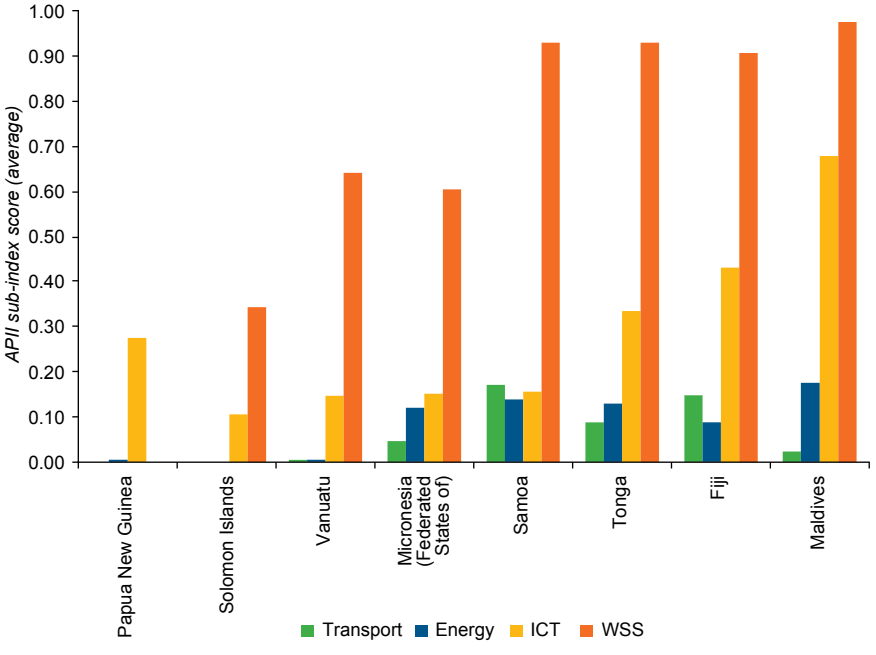
Note: APII for 2015 was computed from the three-year averages between 2013-2015.

(a) Transport sector

Two indicators for the transport sector were used to compute a composite index of this sector and to enable analysis of the progress and level of differences at the country level as well as between country groups: (a) road density (i.e., total road routes per 1,000 km^2 of land area); and (b) the railway line density (i.e., total rail routes per 1,000 km^2 of land area). The availability of roads and railways systems are indicative of improved access to rural areas, and contribute to reducing transport costs within countries, with the sub-index shown in figure 2.6.[1]

This shows that the transport sector increased in 14 of the 23 CSN group. Among the CSN, the index deteriorated for

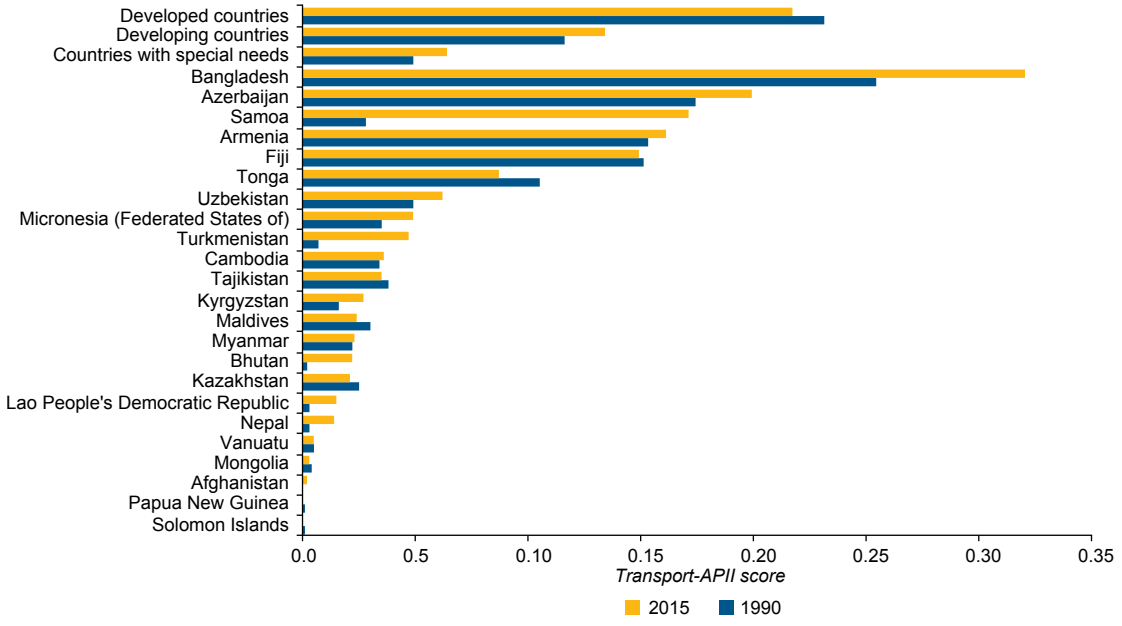
Figure 2.5. Access to Physical Infrastructure Index scores in small island developing States, 2015



Source: ESCAP.

Note: APII for 2015 was computed from the three-year averages between 2013-2015.

Figure 2.6. Transport sector index score, selected countries in Asia and the Pacific



Source: ESCAP.

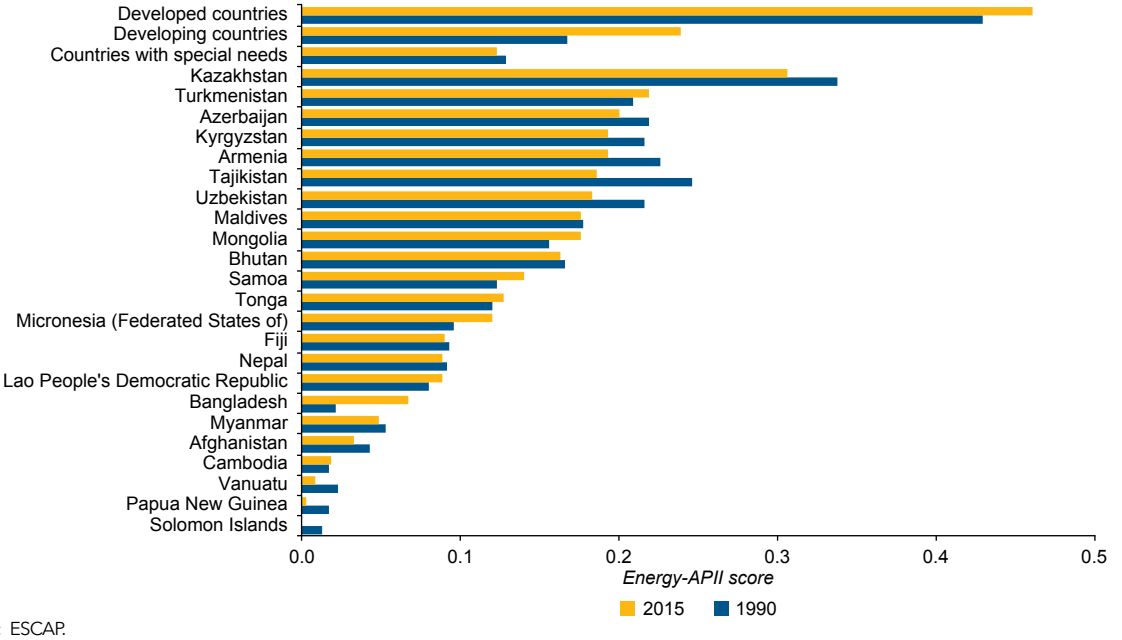
Note: APII for 2015 and 1990 was computed from the three-year averages between 2013-2015 and 1988-1990, respectively.

Tonga, followed by Maldives and Kazakhstan. The largest increase in scores was recorded in Samoa, Bangladesh and Turkmenistan.

(b) Energy sector

Two indicators for the energy sector were used to evaluate the changes across countries and time: (a) access to electricity (per cent of total population); and (b) electric power consumption (kWh per capita). This excludes indicators on the rate of improvement in energy efficiency and renewable energy due to the lack of data for historical data for all selected countries. Figure 2.7 shows that 8 of the 23 countries registered improvements in their energy sector infrastructure in the CSN group.

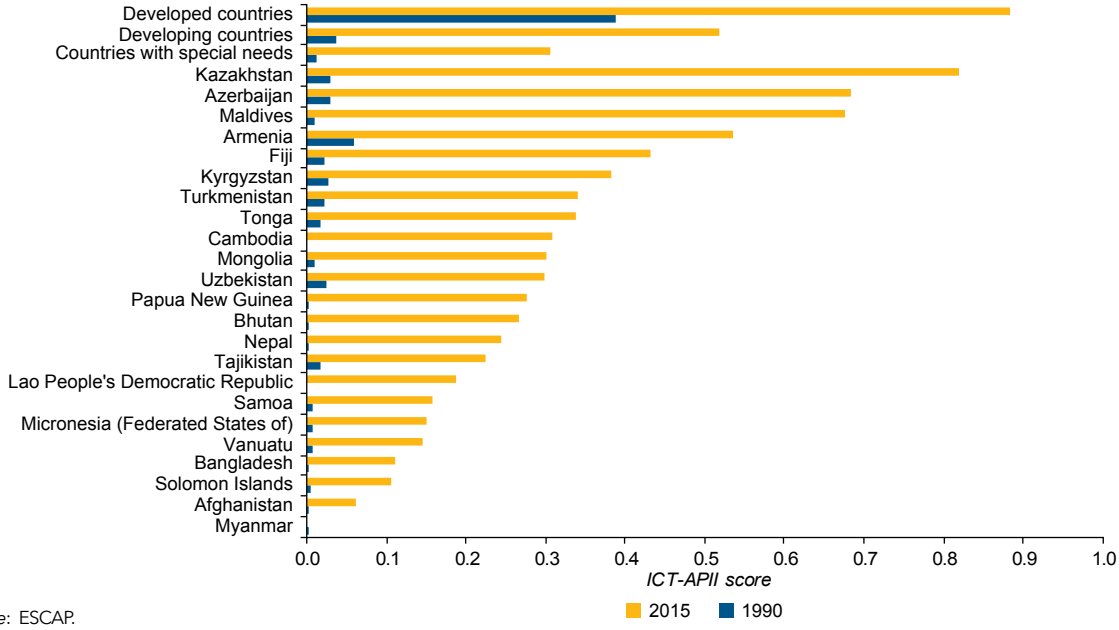
Figure 2.7. Energy sector index score, selected countries in Asia and the Pacific



Source: ESCAP.

Note: APII for 2015 and 1990 was computed from the three-year averages between 2013-2015 and 1988-1990, respectively.

Figure 2.8. ICT sector index score, selected countries in Asia and the Pacific



Source: ESCAP.

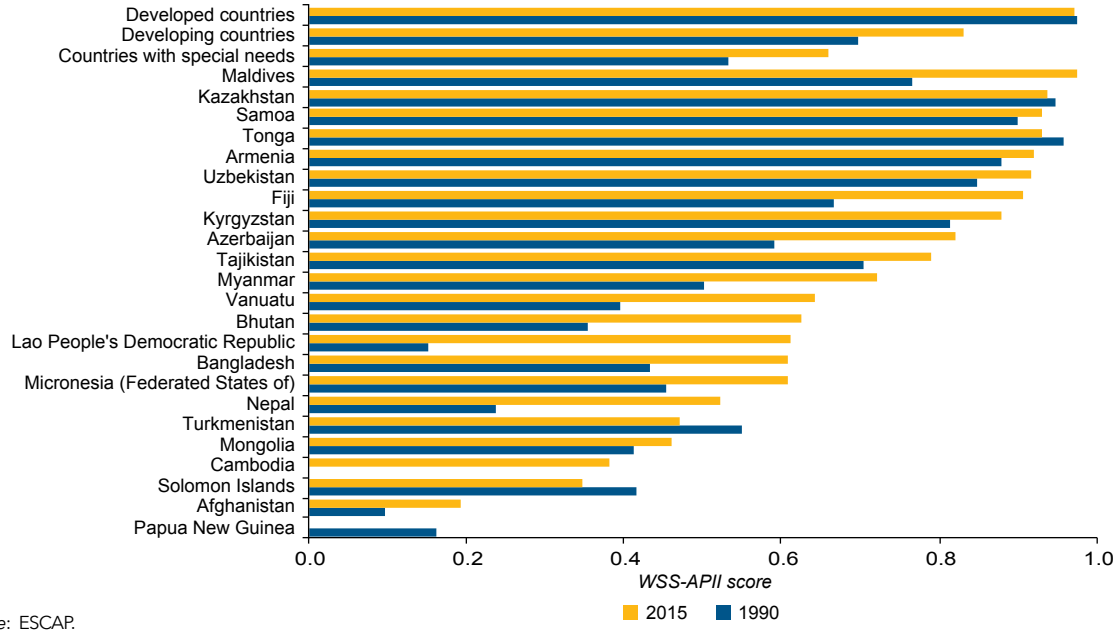
Note: APII for 2015 and 1990 was computed from the three-year averages between 2013-2015 and 1988-1990, respectively.

For example, Bangladesh, Federated States of Micronesia and Mongolia witnessed significant improvement between 1990 and 2015. In contrast, Tajikistan experienced a decline in its score. In Bhutan and Maldives, both of which have very low scores, there was a slight decline between the two periods.

(c) Information and communications technology sector

The two indicators that were used to evaluate changes across countries and time in access to basic ICT services were: (a) Internet users per 1,000 head of population; and (b) the combined number of subscriptions of mobile phones and fixed telephone lines per 1,000 head of population. Figure 2.8 shows that performance within and between countries in the region improved in terms of access to ICT services for 22 of the 23 countries in the CSN group. In several countries, such as Azerbaijan, Kazakhstan and Maldives, the improvement was significant. Index scores

Figure 2.9. WSS sector index score, selected countries in Asia and the Pacific



Source: ESCAP.

Note: APII for 2015 and 1990 was computed from the three-year averages between 2013-2015 and 1988-1990, respectively.

in Fiji, Kyrgyzstan and Tonga also increased significantly during the past decade due to noticeable changes in their ICT policies such as competition in the mobile market and national broadband policies, among others.

(d) Water supply and sanitation sector

The sub-index for WSS infrastructure comprises two indicators: (a) the percentage of the population that has access to improved water sources; and (b) the percentage of the population that has access to improved sanitation facilities. Figure 2.9 shows that the index scores for WSS increased in 18 of 23 CSN. In Cambodia, the Lao People's Democratic Republic and Nepal, the index scores increased significantly. The largest decline in index scores was recorded in Papua New Guinea, Solomon Islands and Turkmenistan.

C. ECONOMIC IMPACTS OF INFRASTRUCTURE

Infrastructure development should accelerate the level of economic growth and spread the benefits of development to all segments of society, especially in those countries where the level of development is still low. Improvement in infrastructure facilities can be one of the key drivers of sustainable development. The economic impacts of infrastructure are therefore important for paving the way for robust national and regional policymaking and its alignment with overall economic policies and designing.

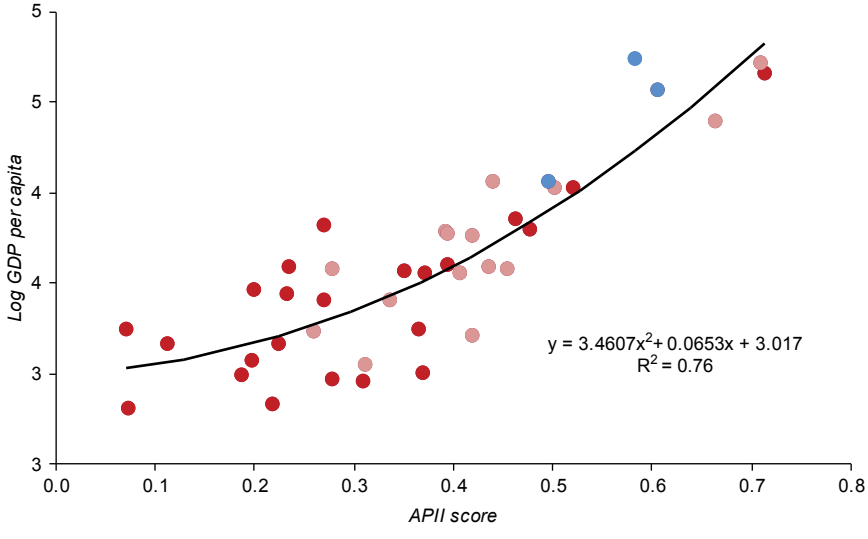
1. Infrastructure and GDP per capita

In this context, the literature has generally confirmed the positive relationship between infrastructure, growth and levels of income. For example, while McKinsey Global Institute (2016) found that every United States dollar spent on infrastructure generated a socio-economic rate of return of about 20% in the long term, PWC (2014) estimated an economic return of 5% to 25%. The APII scores, as shown in figure 2.10, demonstrate a close relationship to levels of GDP per capita in the 41 countries in the region.

The results clearly show that the level of the provision of physical infrastructure services was strongly correlated with GDP per capita in 2015. A similar scatter plot for 1990 was also produced in order to understand the level and significance of correlation between GDP per capita and APII score (figure 2.11). The results indicate that the size of correlation remained exactly the same during the past two decades. However, the relationship between the two indicators have shown stronger responsiveness during the same period.

Various studies have identified a significant link between improvement in infrastructure at the sectoral level, and the subsequent impact on economic growth. For example, exploring the role of transportation, energy and telecommunications infrastructure in sustaining Asia's growth, Brooks and Go (2011) indicated that fixed telephone lines and mobile phones contribute most to real GDP growth in low-income countries, with an

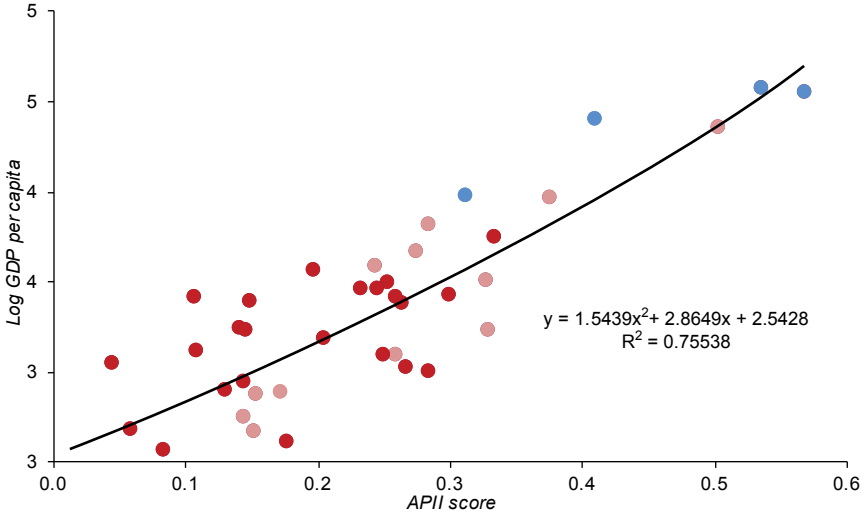
Figure 2.10. Access to Physical Infrastructure Index scores and GDP per capita in selected Asia-Pacific countries, 2015



Source: ESCAP.

Note: Blue circles denote developed economies, pink circles denote developing economies and red circles denote CSN.

Figure 2.11. Access to Physical Infrastructure Index scores and GDP per capita in selected Asia-Pacific countries, 1990



Source: ESCAP.

Note: Blue circles denote developed economies, pink circles denote developing economies and red circles denote CSN.

income elasticity of 0.04. Transport infrastructure (roads) contributes the most to the income growth in lower-middle income countries, with income elasticity of 0.23, while the combination of road and rail networks contributes the most to growth in upper-middle income countries, with an income elasticity of 0.28. When narrowing the analysis to Asia, the income elasticity (i.e., per cent change in mobile/fixed telephone lines is associated with a per cent change in income) of telecommunications infrastructure is almost 0.09, while the impact of transport and energy infrastructure is rather inconclusive. However, the rail and road network variables have positive and significant impacts on the output variable, respectively, but the combined rail and road network variable does not change the output significantly. Also, energy generation has a significant impact on output, while energy consumption – the actual use of energy – does not.

Analysing the data from 41 countries in the region shows that improvements in transport, energy, ICT and WSS are positively correlated with GDP per capita at the regional level (figure 2.12). However, the level of correlation varies across dimensions of the APII, while there was a strong positive correlation between energy and ICT scores and GDP per capita in 2015. The correlation between the transport sector and GDP per capita in 2015 was positive but very low, whereas a 'U-shaped' relationship is shown between WSS infrastructure and GDP per capita, implying that after a certain level, the improvement in WSS-infrastructure would further increase real GDP per capita.

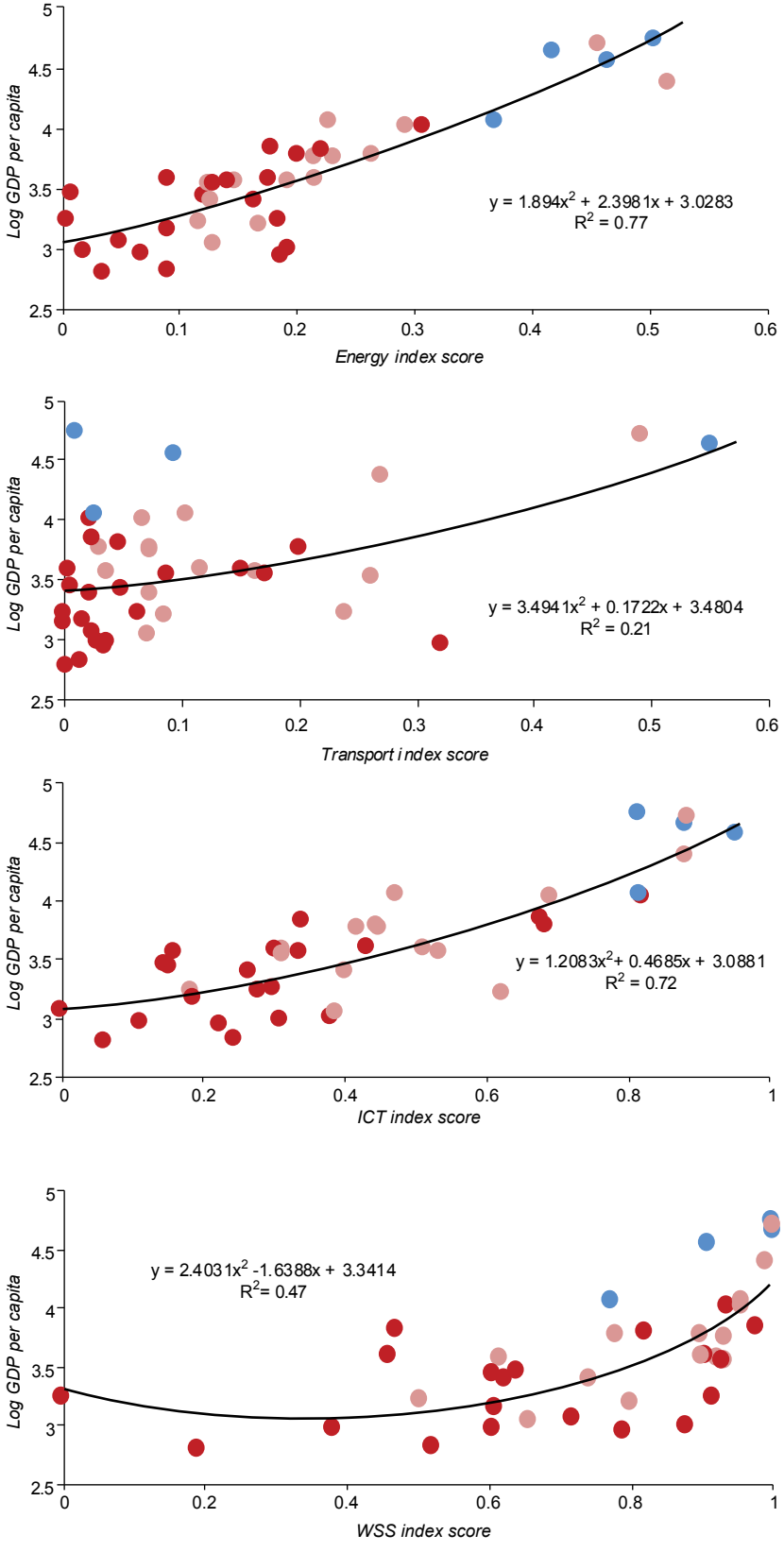
2. Infrastructure and human development

Comparison of similar correlations in the 1990s indicates that WSS was correlated much more positively and significantly. Thus, low access to physical infrastructure in the CSN is constraining economic growth by, for example, limiting the potential of these economies to structurally diversify as well as limiting access to health and education. Poor physical infrastructure is also limiting CSN in making the transition to a faster and better development trajectory (ESCAP, 2015a). At the same time, the limited availability of infrastructure disproportionately affects the poor and the rural population, and has a negative impact on efforts to reduce extreme poverty.

On a similar note, the improvements in APII further indicate that overall improvement in infrastructure access plays an important role in increasing human development by sharing the benefits across social sectors such as health and education. Indeed, the Asia-Pacific sample of 41 countries reveals how the CSN group index scores are correlated with their levels of development, as measured by the Human Development Index (HDI) (figure 2.13). Importantly, the correlation between HDI and GDP per capita was lower in 1990 compared with 2015, while there was always a positive and statistically relationship between these two dimensions during the past two decades.

This highly significant correlation suggests that policies to improve access to physical infrastructure play a critical

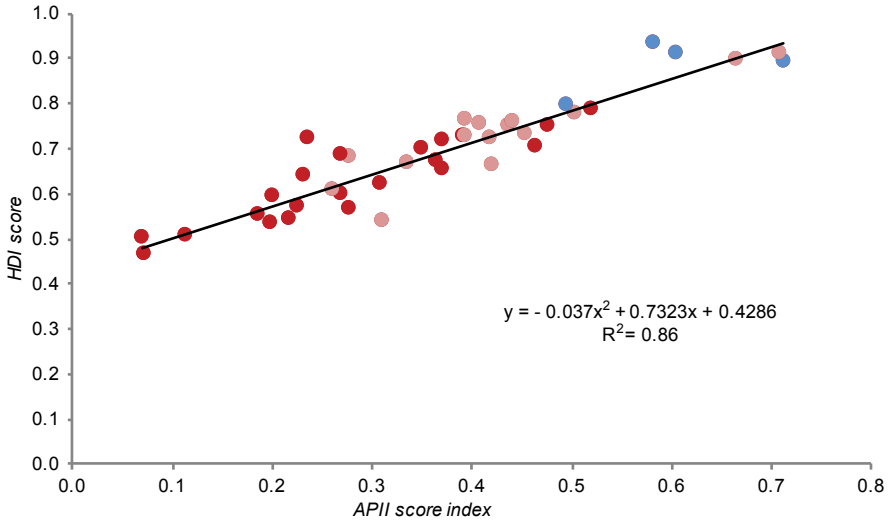
Figure 2.12. Access to Physical Infrastructure Index scores by sector and GDP per capita in selected Asia-Pacific countries, 2015



Source: ESCAP.

Note: Blue circles denote developed economies, pink circles denote developing economies and red circles denote CSN.

Figure 2.13. Access to Physical Infrastructure Index scores and Human Development Index in selected Asia-Pacific countries, 2015



Source: ESCAP.

Note: Blue circles denote developed economies, pink circles denote developing economies and red circles denote CSN.

role in achieving sustainable development in CSN. The results indicate that with robust and systematic policies in infrastructure sectors, countries – irrespective of their level of development – can experience a high impact on development. Policies to improve infrastructure therefore play an important role in raising economic growth and levels of human development.

It is evident that infrastructure across all sectors serves a common purpose, namely to deliver services to people and to improve development outcomes. Deficiencies of infrastructure thus present a bottleneck to economic growth and a risk to business competitiveness, a factor that contributes to growing inequality and is an obstacle to poverty reduction. This is also an impediment to effectively pursuing SDGs and other internationally-agreed development goals, especially in CSN where the level of infrastructure is lagging considerably and availability is limited.

3. Estimating the impacts of infrastructure

Quantitative analysis provides some interesting and causal patterns (see annex IV), as the non-parametric estimates of the responsiveness of real GDP to changes in the APII and its four sectors for various country groups, including Asia and the Pacific, CSN and least developed countries, from 1990 to 2015 demonstrate (Das, Basu and Shashoua, 2017).

The analysis shows that improvements in APII scores has had an impact on real GDP during the past two decades when using various economic policy variables such as government consumption, trade and credit policies, especially for the private sector. These complementary economic policies are critically important in ensuring that Government-led policies in the infrastructure sector can benefit economic activities that further provide incentives to improve the institutional infrastructure.

The assessment of the results (annex IV, table A3) reveals several key policy implications: first, the relatively improved level of the APII score has a significant positive impact on real GDP for the whole of Asia-Pacific, while the impact on CSN and least developed countries is slightly lower but statistically highly significant. Specifically, in these cases, if the APII score increases by 1%, GDP increases by 1.33% for the whole of Asia and the Pacific region. This relationship is also statistically significant. In other words, the relationship between the APII score and economic growth is, ceteris paribus, positively significant for over 50% of the countries in the sample. However, across groups, the results show that the size and significance of the results vary as well in descending order; CSN (GDP increases by 1.19%) and least developed countries (GDP increases by 1.02%) in the case of APII score (annex IV, table A1).

Second, improvements in the APII scores have positive and significant impacts on human development. For example, annex IV, table A2 shows that a 1% increase in APII will increase HDI for the whole sample of Asia and the Pacific by 0.33%. A 1% increase in APII will increase HDI in CSN by only 0.32%. In the case of least

developed countries, a 1% increase in APII will increase HDI by only 0.29%.

Thus, while at all levels, APII has a positive and significant impact on human development outcomes, better APII scores in developed and developing countries may have a stronger impact on human development compared to CSN. At the policy level, this implies that infrastructure development policies need to be undertaken in a much more robust and systematic manner at the national level to ensure that benefits are spread to all levels of society. Importantly, higher levels of infrastructure development have a highly significant impact on the GDP of all country groups, highlighting the point that improvement of access to physical infrastructure will raise the level of GDP per capita; this holds true for increasing the overall level of human development outcomes.

Third, governance plays an important role in determining the way in which policies can be administered in an effective and beneficial manner. In this context, the analysis shows that property rights, a measure of quality of institutions, is categorized into three groups: low, medium and high. The second quartile shows positive significance for the APII scores of all three groups. The positive significance of APII and GDP per capita and APII and HDI relationship holds as the quality of property rights improves. This implies that with a higher quality of institutions or property rights, an improved APII may have a much larger positive and significant impact on growth and development (annex IV, tables A3 and A4).

Fourth, at the sectoral level, the analysis highlights that, if the APII score increases by 1% in WSS, GDP increases by 0.89% and HDI increases by 0.32%, respectively, for CSN economies. In the case of a 1% increase in energy sector index, real GDP increases by 0.83% and HDI increases by 0.21%, respectively for CSN (annex IV, tables A5 and A10). As in the case of overall improvement in APII scores, the sectoral APII scores are dependent on the level of institutional quality (annex IV, tables A6 to A9 for GDP and tables A11 to A14 for HDI).

4. Estimating gains from infrastructure investment

The results reported in this section are based on the Global Trade Analysis Project (GTAP) computable general equilibrium model, which was used to estimate the potential economic impact of improving access to infrastructure in CSN in monetary terms. The global computable general equilibrium modelling framework of GTAP is a useful tool for ex ante analysis of economic outcomes of different economic cooperation scenarios among countries. Annex V presents the description of the GTAP model (Raihan and Basu, 2017).

This study simulates three scenarios of infrastructural development using the GTAP model:

(a) The first scenario is a base case scenario ('Catch') in which: (i) countries whose APII in 2015 was below the average of CSN are forecast as reaching the APII score by 2030 that other developing countries had in 2015 (i.e., have an APII of 0.431; see table 2.1); (ii) countries whose APII is 2015 was sufficiently above the average of CSN are assumed to reach the score of developed economies in 2015 (0.633); and (iii) countries whose APII was near the average of CSN are assumed to reach the average of the two scores (0.532).

(b) In the second scenario ('Catch-U'), uncertainty has been included by assuming that countries in the model may face uncertainties emanating from regional/global economic downturns, climate change-related shocks and/or changes in the alignment of national priorities for infrastructure development projects. This uncertainly implies that the catch-up with other countries will be delayed by five years, such that the scores in the base scenario for 2025 are the level that they will reach by 2030;

(c) In the third scenario ('Catch-U-RECI'), uncertainty exists, as above, but this delays the achievement of the scores by only two years. One possible interpretation of this scenario could be that regional economic cooperation and integration (RECI) contributes to reducing the impact of uncertainty;

On the basis of these assumptions, table 2.2 presents the projected APII score for 2020, 2025 and 2030 under these three scenarios, all of which are run under the GTAP closures where factor endowments, technology, and tax and subsidy rates are exogenous variables.

Figure 2.14 presents the results of the impact on national income three scenarios for the Asia-Pacific region's CSN.[2] For all countries, the base case scenario will generate the largest gains in national income. Under this base scenario, the increase in national income of CSN will be as high as $134 billion by 2030, i.e., approximately 6% of the level of national income of those countries. Estimated national income gains for Bangladesh, Kazakhstan, and a combination of Tajikistan, Turkmenistan and Uzbekistan are $35.5 billion, $26.6 billion and $16.5 billion, respectively. The national income gains will be the largest for Bangladesh and the lowest for Kyrgyzstan. This illustrates the importance and potential benefits of raising financial resources to implement infrastructure development policies in CSN.

Table 2.2. Projection of the Access to Physical Infrastructure Index scores for selected Asia-Pacific countries

	APII score	Base case scenario (Catch)			Base case scenario w/ uncertainty (Catch-U)			Base case scenario w/ uncertainty but RECI (Catch-U-RECI)		
Country	2015	2020	2025	2030	2020	2025	2030	2020	2025	2030
Afghanistan, Bhutan and Maldives	0.268	0.318	0.431	0.532	0.293	0.318	0.431	0.308	0.386	0.491
Armenia	0.453	0.543	0.633	0.633	0.498	0.543	0.633	0.525	0.597	0.639
Azerbaijan	0.476	0.566	0.633	0.633	0.521	0.566	0.633	0.548	0.606	0.639
Bangladesh	0.277	0.327	0.431	0.532	0.302	0.327	0.431	0.317	0.389	0.491
Cambodia	0.186	0.236	0.326	0.431	0.211	0.236	0.326	0.226	0.290	0.389
Kazakhstan	0.520	0.532	0.633	0.633	0.526	0.532	0.633	0.529	0.593	0.639
Kyrgyzstan	0.370	0.460	0.532	0.633	0.415	0.460	0.532	0.442	0.503	0.593
Lao People's Democratic Republic	0.225	0.275	0.365	0.431	0.250	0.275	0.365	0.265	0.329	0.404
Mongolia	0.235	0.285	0.375	0.431	0.260	0.285	0.375	0.275	0.339	0.408
Myanmar and Timor-Leste	0.198	0.248	0.338	0.431	0.223	0.248	0.338	0.238	0.302	0.394
Nepal	0.217	0.267	0.357	0.431	0.242	0.267	0.357	0.257	0.321	0.401
Pacific island developing States	0.247	0.297	0.387	0.431	0.272	0.297	0.387	0.287	0.351	0.413
Tajikistan, Turkmenistan and Uzbekistan	0.314	0.404	0.494	0.532	0.359	0.404	0.494	0.386	0.458	0.517

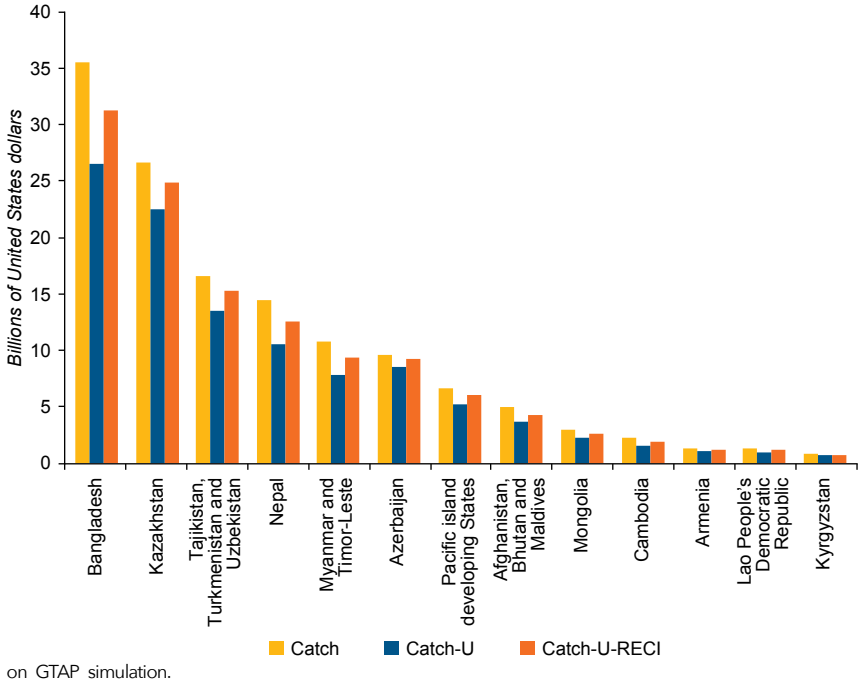
Source: ESCAP.

Note: Some countries have been grouped together for the estimation.

It is should be noted that under the second scenario – the base scenario with uncertainty – the negative cumulative impact on national income would be about 20% by 2030. In this scenario, the role of regional economic cooperation and integration could play an important role, as enhanced regional economic cooperation – for example, through regional financial cooperation – could add more than $16 billion to the national income of CSN by 2030.

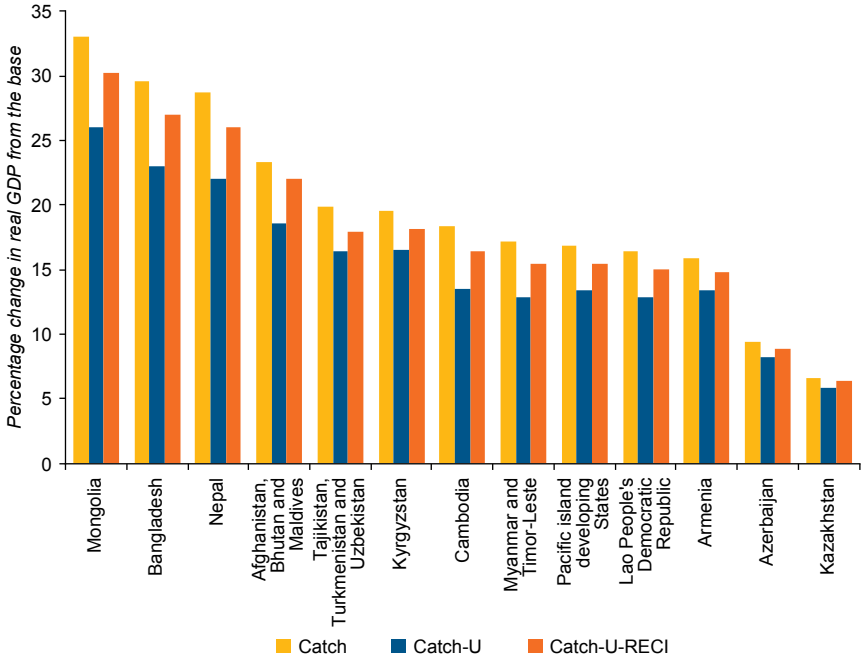
Examining the results from this simulation exercise on a country-by-country basis reveals that, in terms of percentage change in real GDP, Mongolia would gain the most, while Kazakhstan would gain the least (figure 2.15).

Figure 2.14. Total national income increase in billion United States dollars, 2015-2030



Source: ESCAP based on GTAP simulation.

Figure 2.15. Percentage change in real GDP during 2015-2030

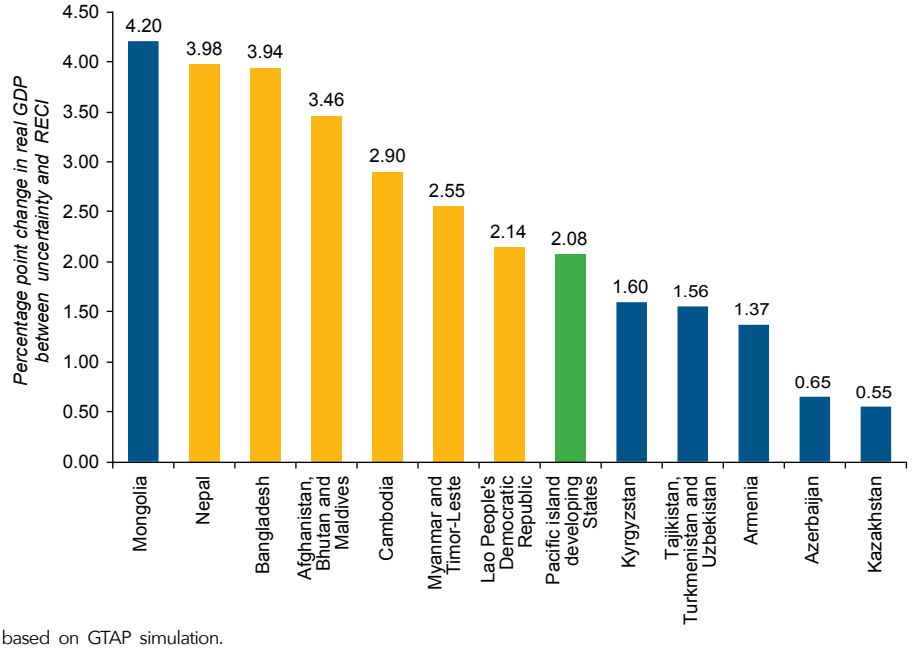


Source: ESCAP based on GTAP simulation.

There are marked differences in gains, in terms of percentage change in real GDP between the second and third scenario ('Catch-U' and 'Catch-U-RECI') (figure 2.16). The largest gain would be for Mongolia, followed by Nepal, while Kazakhstan would gain the least.

The GTAP simulation analysis further implies that securing financing sources and/or appropriate modalities for infrastructure development in CSN must be frontloaded so that over the medium-term to long-term, these countries can reach the level of development of their infrastructure

Figure 2.16. Percentage point change in real GDP between Catch-U and Catch-U-RECI



Source: ESCAP based on GTAP simulation.

to that of the developing and developed countries by 2030, as measured by their APII scores.

D. CONCLUDING REMARKS

This chapter has presented the ESCAP Access to Physical Infrastructure Index, which clearly demonstrates that while there has been a notable improvement in the level of infrastructure development in CSN since 1990, significant gaps remain, relative to other developing and developed countries in the Asia-Pacific region.

Greater levels of infrastructure development have contributed to accelerated levels of economic growth and human development outcomes. However, there is a large degree of divergence across CSN and other developed and developing countries in the region. The positive relationship between the Access to Physical Infrastructure Index and other indicators of development highlight the importance of accelerating support measures for development and maintenance of physical infrastructure at the national and regional levels.

While this chapter has highlighted the fact that CSN face significant infrastructure gaps relative to other developing countries in the region, it has not yet been elaborated how countries can leverage the significant amounts of financial resources that infrastructure development requires. The following chapter of this report pays more attention to this aspect by laying out what investments are directed towards infrastructure in CSN and what potential financing gaps those countries face. It also points to possible modalities for bridging these gaps.

In sum, infrastructure development planning is a long-term process in which Governments need to ensure that such planning follows a strategic framework to spread its benefits across all citizens. Doing so will increase economic growth, create employment prospects and contribute to sustainable development. However, a specific set of policy measures and reforms from the Governments, together with active participation by the private sector, are essential to overcoming infrastructure bottlenecks, especially in CSN. Policymakers can follow the framework described above in order to create a national platform for policy design and implementation by bringing various sectors together in a more coherent manner and by strengthening governance structures.

ENDNOTES

1 While these indicators do not necessarily reflect the quality of the transport sector, this chapter discusses possible quality indicators.

2 In the GTAP model, economic welfare is represented as being derived from the allocation of national income between private consumption, government consumption and savings. National income is nominal net national product, and is equal to GDP less depreciation less net income payments to foreigners (Hanslow, 2000).

CHAPTER 3
FINANCING STRATEGIES FOR OVERCOMING INFRASTRUCTURE GAPS

Infrastructure financing requirements in the Asia-Pacific region, which are already large, will continue to increase in response to a rising demand for infrastructure stemming from the region's rising wealth, its growing population, and rapid urbanization. Additional resources will also be needed to make the infrastructure more sustainable and climate-resilient, particularly in small island developing States and other low-lying coastal areas. Even at present, Governments in the region are unable to meet these financing requirements through traditional sources, such as tax revenue, official development assistance (ODA) and funding received by multilateral development banks (MDBs). Meeting future infrastructure financing needs therefore will require greater engagement of the private sector and other new donors, such as China and India, to ensure that sufficient resources can be raised for investment in infrastructure.

Estimates of infrastructure financing needs vary considerably. For example, ESCAP (2015b) estimated that the Asia-Pacific region will need to mobilize between $800 billion and $900 billion annually for the provision of transport infrastructure services, ICT, WSS and electricity access. Bhattacharyay (2012) reported that Asia and the Pacific will need to spend approximately $8 trillion in infrastructure investment during 2010-2020, equivalent to $800 billion per year, in order to maintain current levels of economic growth. Similarly, Fay and Toman (2011) estimated that up to an additional $1.5 trillion would be necessary annually through 2020 to help low- and medium-income countries establish adequate levels of infrastructure. Most recently, ADB (2017) estimated that developing countries in Asia will need to invest $26 trillion from 2016 to 2030, or $1.7 trillion per year.

These estimates vary, dependent upon assumptions on future infrastructure needs, estimated rates of economic and population growth, assumed increases in rates of urbanization, and policy shocks. Moreover, as there is no universal database on infrastructure investment, different databases follow their own definitions and cover different aspects of infrastructure investment. In addition, a lack of data can obscure what is needed at a project level. For example, data on projects or plans are often not available so the cost of these projects must be estimated, with varying assumptions based upon costs of past infrastructure projects that are assumed to be in line with best practice scenarios.

Quantifying infrastructure financing needs for CSN adds an additional layer of complexity as information on the magnitude of past investment is often not available. Thus, although some studies have included CSN as the "rest" of the world or of the region, those estimates are typically extrapolated from data for other countries (see, for example, McKinsey Global Institute, 2013 and 2016).

The main challenge in quantifying financing needs for CSN arises from differences in the nature of infrastructure needs in CSN and other developing countries. In the latter, most needs are a result of either increasing demand for new infrastructure or maintenance of existing infrastructure. Thus, estimating future levels of infrastructure can be based upon historical trends of infrastructure provision and projections of demand arising from population growth, increasing urbanization and per capita income growth assumptions. However, infrastructure needs in CSN may be more related to supply constraints and resulting infrastructure shortages. Therefore, estimates for CSN cannot be based solely on historical trends and need to include a component of financing needs that would be required to fill the existing infrastructure gaps.

ESCAP has therefore developed a framework to estimate the infrastructure financing needs of CSN by taking into account three components: (a) financing that is needed to meet the growing demand for new infrastructure as populations increase and become more urbanized; (b) financing that is needed to effectively maintain existing infrastructure; and (c) financing that is needed to fill existing infrastructure shortages. The framework also considers a scenario in which countries face additional costs in improving infrastructure to mitigate loss and damage caused by climate change or extreme weather events. Box 3.1 summarizes the framework used to estimate infrastructure financing needs in CSN.[1]

According to the estimates for 26 countries for which relevant data are available, the CSN would need to spend on average 8.3% of their GDP per annum ($48 billion in 2010 prices) to: (a) provide universal access by 2030; (b) keep up with growing demands for new infrastructure; and (c) maintain existing infrastructure. Across the three groups of CSN, financing needs of least developed countries are by far the largest, both in terms of volume ($32 billion) and share of GDP (10.7% of GDP). Those of landlocked developing countries and small island developing States are, however, also sizable, estimated approximately at 6.9% and 5.4% of their respective GDP (figure 3.1). At the sectoral level, the transport sector accounts for the bulk of investment needs in least developed countries (56%) and small island developing States (53%), while one-third each is needed for energy infrastructure and transport infrastructure in landlocked developing countries.

Results also indicate that 42% of infrastructure financing needs in least developed countries and 33% of needs in small island developing States arise from their

Box 3.1. Estimating infrastructure financing needs in countries with special needs

The framework estimates the three components of financing needs and one additional scenario incorporating climate change -related costs. All estimates are based on a panel of infrastructure stocks, and macroeconomic and demographic indicators for 68 developing countries, including 26 CSN. The following 11 indicators were used to represent the four sectors of physical infrastructure (transport, energy, ICT and WSS):

(a) Transport – paved and unpaved roads (both expressed as total route km per 1,000 people); and rail lines (total route km per 1 million people);
(b) Energy – power consumption (kWh per capita), and access to electricity (percentage of population);
(c) ICT – fixed telephone subscriptions per 100 people; and mobile telephone subscriptions per 100 people;
(d) WSS – access by rural and urban populations to improved water sources (both expressed as a percentage of the respective populations) and access by the urban population to improved sanitation facilities (percentage of urban population).

Data were available for all the indicators from 1990 to 2015, except for data covering mobile phone subscriptions, which start from 2004. Linear intra/extrapolations are performed to fill in the missing values and thus obtain a balanced data panel.

The framework first estimates the component of financing needs that correspond to the growing demand for new infrastructure, based on the "top-down" approach. This is done by projecting the demand for infrastructure to 2030 under the assumption that infrastructure services are demanded both as consumption goods by individuals and as inputs into the production process by firms, as laid out by Fay (2000), Fay and Yepes (2003), Bhattacharyay (2012), Ruiz-Nunez and Wei (2015) and ADB (2017). Thus, the future infrastructure demand is described by the following process:

$$I_{i,t}^{j} = \alpha_0^j + \alpha_1^j I_{i,t-1}^{j} + \alpha_2^j y_{i,t} + \alpha_3^j A_{i,t} + \alpha_4^j M_{i,t} + \alpha_5^j U_{i,t} + \alpha_6^j P_{i,t} + \alpha_7^j D_i^j + \alpha_8^j t$$

where $I_{i,t}^{j}$ is the demand for infrastructure of type j in country i at time t; $y_{i,t}$, $A_{i,t}$ and $M_{i,t}$ represent, respectively, the GDP per capita and shares of agriculture and manufacture value-added in GDP; $U_{i,t}$ and $P_{i,t}$ stand for the urbanization rate and the population density; D_i^j is the country fixed effect; and t is a time trend, used to capture time effect. The regression coefficients are estimated with ordinary least squares. All variables in the equation are expressed in natural logs to linearize the model. Due to the absence of future estimations for GDP composition, they are considered constant since 2015.

Once the new infrastructure demand is projected to 2030, financing needs can be calculated by applying it to a range of unit cost estimates provided by the World Bank and IEA (2015) and IEA (2016) for electricity, Collier, Kirchberger and Söderbom (2015) and ADB (2012) for transport, Ruiz-Nunez and Wei (2015) and ADB (2017) for ICT and WHO (2012) for WSS.

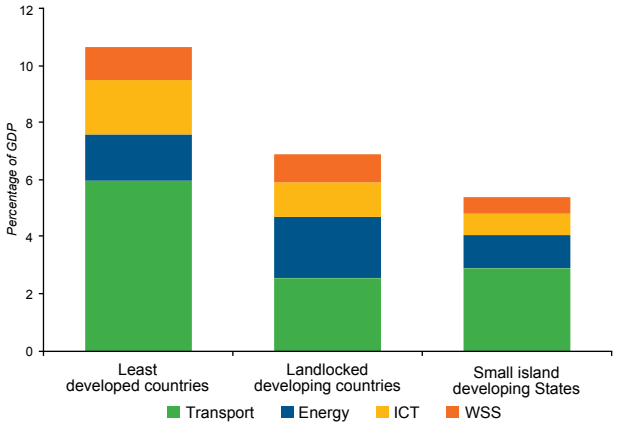
The second component, financing needed to effectively maintain existing infrastructure, is obtained by applying depreciation rates to the predicted total value of infrastructure stocks. For WSS indicators, country-specific maintenance costs estimated by WHO (2012) are employed. For other sectors, the maintenance costs are a function of the value and the composition of existing infrastructure stocks (e.g. the current composition of energy mix).

The third component is calculated as the costs of reaching the "unserved" by 2030, based on the same unit cost estimates used to estimate the first component of financing needs. While there is no obvious "optimal" level of infrastructure that can be used to define the level up to which infrastructure gaps need to be filled, this framework uses universal access to electricity and water and sanitation by 2030 as a normative target. Since defining universal access to public transportation and telecommunications is less obvious, the provision of access that meets the average access rate that exists in other developing countries in the Asia-Pacific region is used as the normative target for CSN.

The scenario incorporating climate change-related costs considers three elements: (a) additional capital and maintenance costs for climate-resilient infrastructure; (b) additional capital and maintenance costs for new electricity-generating capacity from green sources; and (c) cost of protecting infrastructure against changes in rainfall and temperature due to average climate change.

Source: Branchoux, Fang and Tateno (2017).

Figure 3.1. Annual infrastructure financing needs, 2016-2030



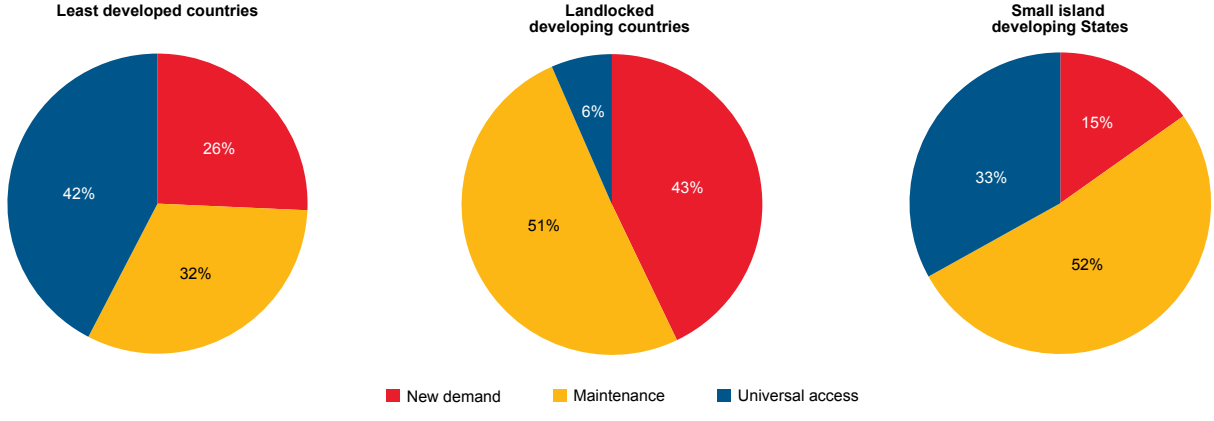
Source: ESCAP.

infrastructure shortages, particularly in the transport and the energy sectors (figure 3.2). This finding, while justifying the inclusion of this component of financing needs into the framework, indicates that provision of universal access to basic infrastructure services would require large outlays of resources in these counties. For landlocked developing countries and small island developing States, more than one-half of financing needs is accounted for by costs of maintenance and replacement of existing assets.[2]

These estimates would be even larger if new demand for infrastructure related to climate change was incorporated, particularly as small island developing States and other low-lying coastal areas face substantial long-term costs in improving infrastructure to mitigate loss and damages caused by climate change or extreme weather events. On average, CSN need an additional investment of 1.8% of GDP per annum for new infrastructure to be climate-resilient and a further 0.4% for new electricity-generating capacity from green sources.[3] In sum, the total financing needs for infrastructure development in CSN are estimated at 10.5% of GDP per annum. The needs are particularly acute in the small island least developed countries such as Timor-Leste (21.1% of GDP) and Kiribati (14.4% of GDP) and in the landlocked least developed countries such as Afghanistan (18.5% of GDP) and Nepal (15.7% of GDP).

Given their limited resource availability and these significant investment needs, CSN face major challenges in accessing sufficient and appropriate financing from public and private sources as well as domestic and external sources. This chapter therefore reviews financing modalities to identify how CSN can narrow their infrastructure financing gaps and how they can overcome some of the factors that are limiting their ability to do so. Section A presents an overview of sources and instruments that are available for infrastructure financing in CSN, including domestic public resources, private resources and international institutions. Section B discusses some new financing vehicles and mechanisms while section C points to some of the financing challenges that CSN face. Section D presents some policy recommendations and draws conclusions.

Figure 3.2. Composition of infrastructure financing needs, 2016-2030



Source: ESCAP.

A. OVERVIEW OF INFRASTRUCTURE FINANCING SOURCES IN COUNTRIES WITH SPECIAL NEEDS

Investing in infrastructure requires significant public policy interventions as infrastructure is a unique asset class, being characterized by high up-front capital costs, long gestation periods, large externalities and a significant sensitivity to country risks (see box 3.2 for a detailed discussion). Such investment can be financed through various mechanisms. Domestically, Governments can tap public sector resources, undertake collaborative initiatives with the private sector to draw upon the resources of both parties as well as foster initiatives that are led by private investors. Externally, official development assistance (ODA), through bilateral arrangements and support from multilateral agencies such as multilateral development banks (MDBs) and other regional and international organizations, have been major sources of infrastructure finance. Foreign direct investment (FDI), including through public-private partnerships (PPPs), and assistance from new actors of development cooperation such as non-DAC donors, new regional initiatives and infrastructure funds, are increasingly seen as a viable solution to meeting the infrastructure needs of CSN.

In the CSN, the domestic public sector has been the traditional provider of infrastructure financing, accounting for the majority share of total infrastructure spending. Although the composition of capital for infrastructure investment varies significantly across countries, depending primarily on country-specific policy and economic structures, public funding accounts on average for about two-thirds of total infrastructure investment (figure 3.3).

In recent years, however, private sector participation and PPPs have proven to be a valuable mechanism, provided that the right conditions are in place. For CSN, the private sector contributes, on average, around 15% of total infrastructure financing.[4] The remaining 20% is financed almost equally by ODA and support from MDBs. This composition of infrastructure financing is similar to that for other developing countries, but the role of ODA and MDBs tend to be greater in CSN, especially in least developed countries (see, for example, Bhattacharya, Romani and Stern, 2012).

The current financing mix falls yet short of the 10.5% of GDP required for overcoming infrastructure gaps by 2030 as the current total infrastructure financing amounts to only 5-7% of GDP in CSN. This indicates that existing sources of financing are insufficient to meet the large and growing needs of infrastructure financing in CSN, and underscores the importance of a more effective, efficient

Box 3.2. Infrastructure as a special asset class

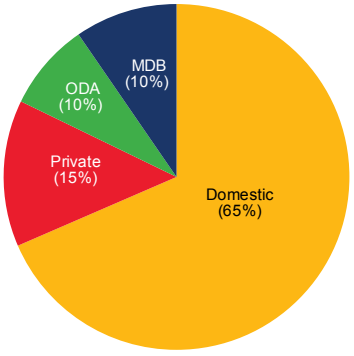
Infrastructure is a unique asset class as it differs from other asset classes in many ways. First, financing costs, particularly high up-front capital costs, can easily outweigh the near-term potential benefits. Infrastructure investments generate cash flows but only after many years, and the initial phase of an infrastructure project is subject to high risks. Second, there are significant externalities associated with the provision of infrastructure. Investment in infrastructure typically bears low financial returns and high social and environmental benefits, of which private investors can only capture a small component. Infrastructure investments are also highly susceptible to coordination failures as they entail complex legal and financial arrangements to ensure proper distribution of payoffs and risk-sharing to align the incentives of all parties involved, thus requiring much expertise (Ehlers, 2014).

Due to these factors, market failures are common in infrastructure financing. Without effective public policy interventions, investment in infrastructure is likely to lead to socially and environmentally inefficient allocation of resources. In addition, research shows that infrastructure investment, in particular private sector finance, is much more sensitive to country risks than investment in non-infrastructure sectors.[a] Among country risks, macroeconomic instability and political risks, such as breaches of contracts and regulatory concerns, have been identified as the main constraints to investment in infrastructure in developing economies. In this context, it is crucial for public policy to address those failures, reduce risk perceptions and improve the overall investment climate in order to effectively leverage both public and private funding sources.

The roles of Governments are further evolving in the context of the 2030 Agenda for Sustainable Development in which they have to ensure infrastructure development gains are shared in an equitable and sustainable manner.

[a] See, for example, Araya, Schwartz and Andres (2013). The paper shows that country risk ratings are a reliable predictor of infrastructure investment levels in developing countries. On average, energy investments exhibit a higher sensitivity to country risk than transport, telecommunications, and water investments.

Figure 3.3. Composition of infrastructure financing sources in countries with special needs



Source: ESCAP compilation based on various sources.

and catalytic use of existing funds to attract private and other emerging sources of finance.

In terms of financing instruments, concessional financing and bank loans have dominated infrastructure finance in CSN. This is partly because the public sector is the main provider of infrastructure financing in CSN, but also because other financing instruments, such as bond and equity, are typically limited – due to insufficiently developed capital markets or their relatively illiquid nature – in their ability to support large infrastructure projects.

Worryingly, the availability of long-term investment financing has diminished since the global financial and economic crisis of 2008, and has not fully recovered due to persistent weakness and uncertainty in the global economy. Public capital expenditures, both from domestic sources and through assistance from development partners, are more likely to be reduced than current expenditures in times of budget constraints, undermining the already weak support for upgrading infrastructure. As a result, traditional financial sources alone cannot be expected to finance the entire infrastructure needs in CSN.

The following subsections review the current state of these infrastructure financing sources and modalities in more detail, and analyse their potential for contributing to infrastructure financing in CSN.

1. Domestic public finance

Infrastructure development has traditionally been financed with domestic public funds. Public finance is particularly crucial in providing public services that are necessary for peoples' daily lives, such as social infrastructure (e.g., hospitals and schools), water and sanitation facilities and basic transport infrastructure. Governments typically pay up front for the capital costs out of their current budgets or public borrowing, and may recover part of that outlay from fees and user charges or future taxes. However, since the provision of those public services usually generates greater social returns than short-term economic profits, it is deemed unnecessary for such infrastructure assets to generate revenue streams that cover capital and operational costs.

Public resources can be disbursed directly by Governments or through public financial institutions such as national development banks. Central and local governments as well as state-owned enterprises (SOEs) can contribute to public investment. The relative importance of these public entities depends on a number of country-specific conditions, including governance systems, and geographic and demographic features. Compared to other developing countries, infrastructure investment is more centralized in the CSN where central Governments account for the majority of public capital expenditure, notwithstanding the fact that subnational and local governments (including public corporations and municipal utilities) have emerged as an increasingly important financing source for infrastructure investment in recent years. Public financial institutions are created to serve public interests and are usually given a clear mandate to address market failures or externalities, and to support the implementation of national development plans and policies (for details, see Cochran and others, 2014 and New Climate Economy, 2016). They have access to high volumes of stable, long-term finance and can use instruments such as state guarantees and high credit ratings to leverage low-cost funding from international capital markets or through the use of household savings.

The way public resources are raised varies across countries. For example, more than a half of public expenditure is sourced from donor grants finance in Afghanistan, Marshall Islands and Nauru. In the region's resource-rich countries, such as Azerbaijan and Timor-Leste, non-tax revenue provides about 60-70% of the funding for general

Governments. However, broadly speaking, a large part of public expenditure is financed by tax revenue – 50-60% in least developed countries and small island developing States, and around two-thirds in landlocked developing countries. On average, the grants portion accounts for one-quarter of total government revenue in least developed countries and small island developing States.

Estimates of public investment in infrastructure are, in general, not possible due to the lack of detailed data and the difficulty in differentiating infrastructure spending from other public spending. Yet, the contribution by the public sector to infrastructure development can be broadly inferred from its share of gross fixed capital formation in GDP, or public investment, as it typically involves investment in physical infrastructure and public buildings such as schools and hospitals.

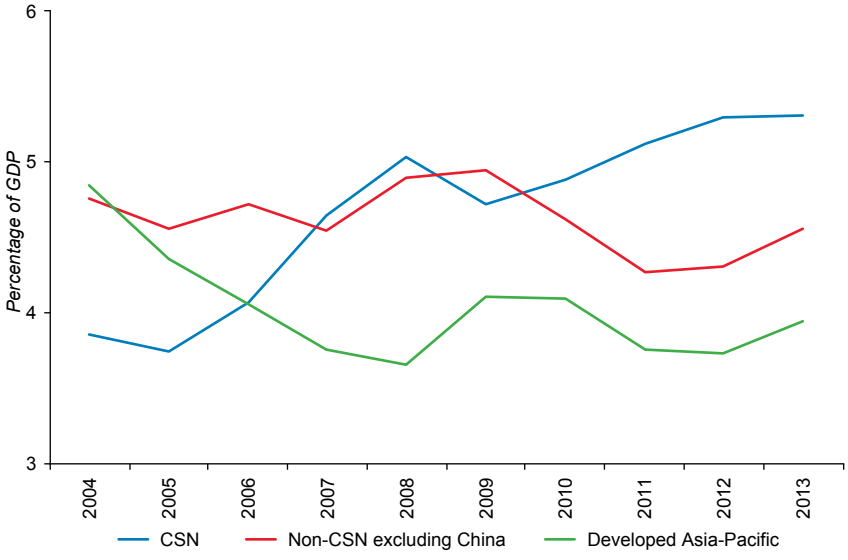
In CSN, public investment has been increasing since 2009, particularly in resource-exporting economies where government spending is supported by high commodity prices and procyclical policies.[5] On average, between 2009 and 2013, public investment represented 5.1% of GDP compared to 4.5% and 3.9% of GDP in other developing countries and developed countries in the Asia-Pacific region, respectively (figure 3.4). Thus, the public sector served as a key financing source of overall investment, including in infrastructure. This large share in CSN is, however, more a result of the small share of private sector contributions to gross fixed capital formation relative to other countries in the region. Moreover, in many other developing countries in the region, Governments are increasingly turning to privatizing the provision of certain economic infrastructure.

Since private sector development is a slow and gradual process, domestic public finance is expected to remain a significant source of infrastructure funding in CSN in the short term. Major challenges and opportunities for the public sector in CSN are discussed in later sections of this chapter.

2. Private sector participation and PPPs

There is growing interest among many CSN in private sector participation and PPPs in infrastructure development and investment. The private sector can be involved in infrastructure development through direct investment (both domestic and foreign), PPPs (joint ventures, concessions, management contracts etc.). The form of private sector participation usually depends on the types of infrastructure assets and the degree of complexity of infrastructure projects. Private financing could be provided to cover upfront costs of infrastructure assets if they can recoup a return from fee-based earning, while those without any obvious revenue streams have little potential to attract private investment unless governments intervene to offer subsidies or sign long-term purchasing agreements. Among private financing, foreign companies have, for example, gained a significant presence in electricity generation, as already seen in the Lao People's Democratic Republic and Myanmar. Foreign private participation could be even higher in large and complex infrastructure projects because of the skills,

Figure 3.4. Public gross fixed capital formation as a share of GDP, 2004-2013



Source: ESCAP calculation based on data from IMF Investment and Capital Stock Dataset, Fiscal Affairs Department, International Monetary Fund. Available at www.imf.org/external/np/fad/publicinvestment/data/data.xlsx (accessed 7 November 2016).

experience and access to finance that they bring (ASEAN and UNCTAD, 2015). In contrast, domestic private funds typically play an active role in the transport sector – roads in particular – although the availability of such funds is somewhat limited in least developed countries and small island developing States.

In the CSN, FDI has been an important form of private sector financing for infrastructure development, particularly in the energy and ICT sectors. Announcements of greenfield investment suggest that the infrastructure sector of CSN received FDI inflows of more than $30 billion between 2011 and 2015 (see the left-hand panel in figure 3.5), which is equivalent to 0.9% of the combined GDP of CSN and around one-fourth of the total greenfield FDI flows to CSN.

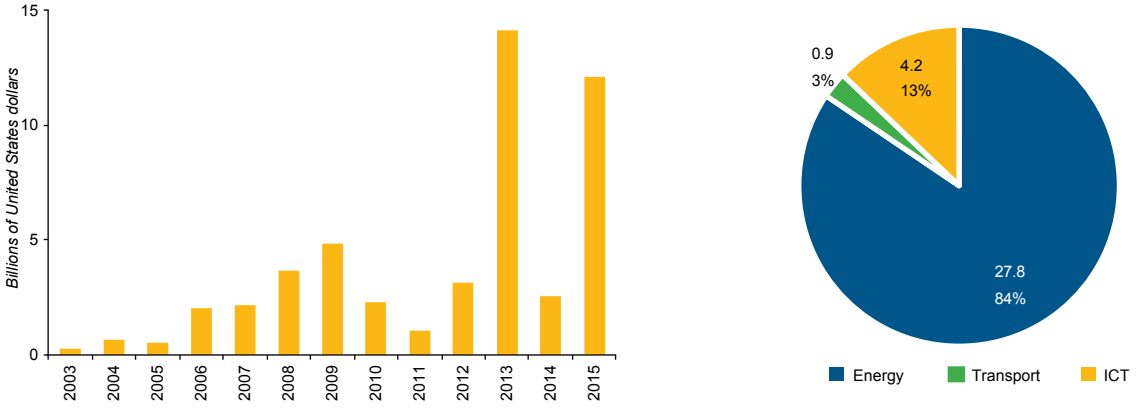
However, greenfield FDI to CSN has been highly concentrated in a small number of mega- projects, primarily in the energy sector; 84% of such flows to CSN was used for development of energy infrastructure and 13% was spent on the ICT sector (see the right-hand panel of figure 3.5).[6] The transport sector accounted for only 3% of total greenfield FDI flows to CSN, while it represented around 30% of FDI inflows in infrastructure industries in non-CSN (UNCTAD, 2016). This underscores the needs and opportunities for CSN to increase private sector participation in the transport sector.

Another concern is that infrastructure FDI projects have been concentrated in a few selected countries and their sources appear to be only one or two economies (table 3.1). For example, Myanmar received more than half of the region's greenfield infrastructure FDI between 2011 and 2015; 55% of total infrastructure FDI in Myanmar during that period was by investors from Japan and Thailand. Similarly, in Bangladesh, the second-largest greenfield FDI recipient among CSN, investors from India accounted for two-thirds of total infrastructure FDI. Other major contributors in the region include Malaysia, China and Singapore. Overall, intraregional greenfield FDI flows accounted for more than 80% of total infrastructure greenfield FDI flows to CSN.

Nevertheless, these FDI numbers underestimate private sector participation in infrastructure since much of these equity investments are used to leverage debts in order to implement infrastructure projects, for instance through PPP arrangements (e.g., build-own-operate and other concessions).

Another way to gauge private sector participation in infrastructure development of CSN is to examine the evolution of PPP investment, which comprises debt and equity financing instruments. Thus, the CSN as a whole received PPP investments equivalent to 1% of their aggregate GDP annually during the past decade, which is above the 0.6% average of other developing countries in the region (figure 3.6). Least developed countries received almost twice as much private infrastructure investment as landlocked developing countries and small island developing States combined. Private contributions

Figure 3.5. Greenfield FDI – capital investment and number of projects in CSN (left panel) and composition of infrastructure FDI in CSN, by type of infrastructure between 2011 and 2015 (right panel)



Source: ESCAP based on data from fDi Markets (accessed 3 January 2017).

Table 3.1. Greenfield FDI in CSN in infrastructure by country of origin and destination between 2011 and 2015, in millions of United States dollars and as a share of GDP

Source country	Amount invested	Host country	Amount received (% of GDP)
Japan	10 088	Myanmar	18 212 (5.9)
Thailand	6 793	Bangladesh	4 610 (0.6)
India	5 213	Kazakhstan	2 475 (0.2)
Netherlands	1 500	Cambodia	2 037 (2.6)
Malaysia	1 379	Tajikistan	1 137 (2.9)
China	1 089	Lao People's Democratic Republic	1 012 (1.9)
United States	1 082	Papua New Guinea	781 (1.0)
Singapore	1 015	Armenia	535 (1.0)
Canada	816	Nepal	429 (0.4)
Sweden	642	Uzbekistan	428 (0.2)
Russian Federation	642	Afghanistan	321 (0.3)
France	486	Azerbaijan	321 (0.1)
Republic of Korea	395	Bhutan	272 (2.9)
Germany	395	Maldives	107 (0.7)
Switzerland	275	Samoa	107 (2.7)
Italy	272	Kyrgyzstan	80 (0.2)
Qatar	214	Mongolia	61 (0.1)

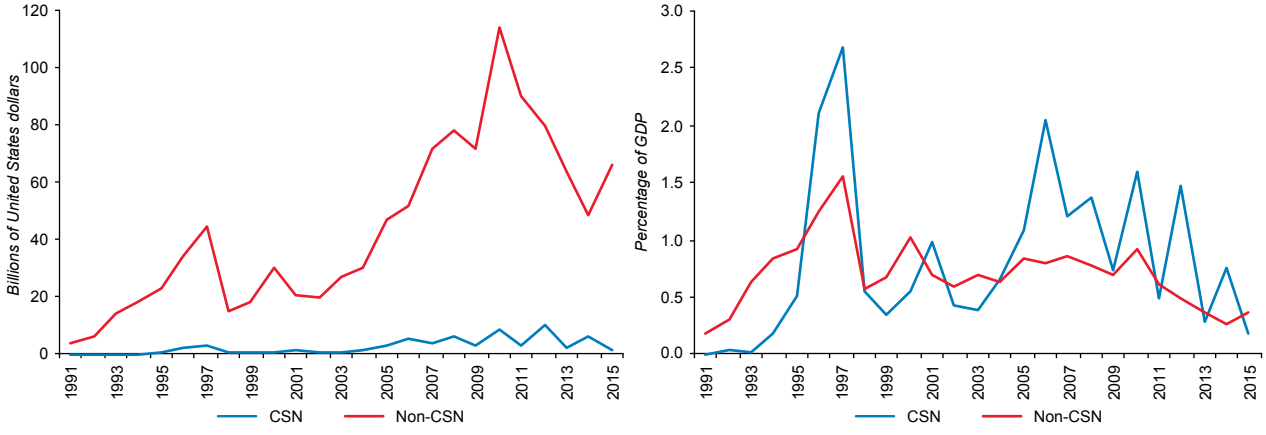
Source: ESCAP compilation based on data from fDi Markets (accessed 3 January 2017).

accounted for about 85% of such investment through equity and debt, while the public sector covered the remaining investment needs through grants or loan financing.

During the past five years, however, PPP has levelled off and even decreased slightly relative to the size of the economies mainly as a result of low commodity prices – which is affecting investment in the energy and mining sector – but also because of the fragile global economy and weak aggregate demand at the global and regional level.

In terms of the sectoral composition, most private sector projects in least developed countries have been in the energy sector, while those in landlocked developing countries and small island developing States have been concentrated in ICT, especially during the past five years (figure 3.7). These two sectors have been the focus of the private infrastructure investments in CSN because they can provide excludable goods where fees can be easily charged and because those sectors have been liberalized over recent years. Although investment for the construction of new power plants has traditionally been the major component of the sector, there has been

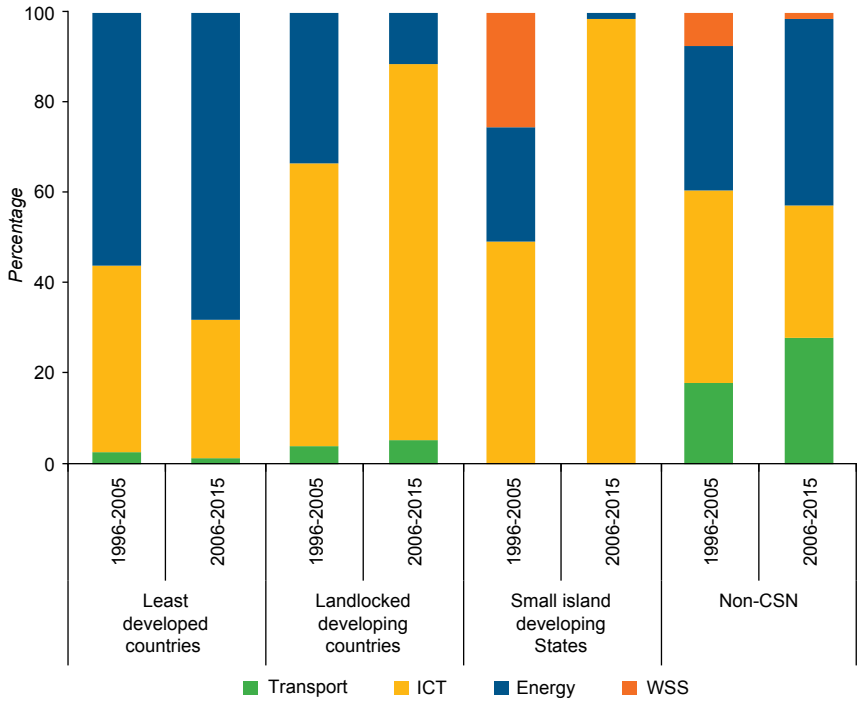
Figure 3.6. Evolution of PPP investment in CSN and non-CSN in Asia and the Pacific



Sources: ESCAP calculations based on data from the World Bank Private Participation in Infrastructure Project Database and ESCAP Statistical Database.

Note: The data capture both public and private contributions to the infrastructure investment. The PPP investment refers initially to commitments only, but adjusted later to actual disbursements, investment or transfers, where information is available.

Figure 3.7. Change in composition of PPP investment, 1996-2005 versus 2006-2015



Sources: ESCAP calculations based on data from the World Bank Private Participation in Infrastructure Project Database and ESCAP Statistical Database.
Note: See figure 3.6.

growing interest in renewable energy in the past few years. In terms of the number of contracts signed in CSN, ICT has been the largest sector for private investments arguably because these assets have less development and construction risks than other types of investments and because demand has been growing rapidly.

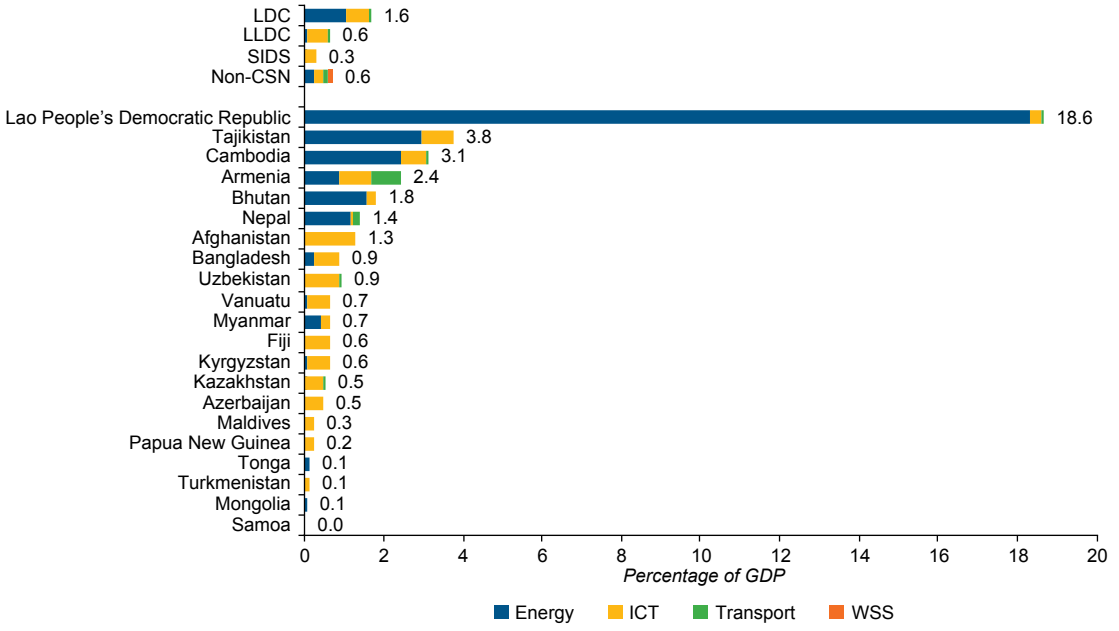
The transport and water and sanitation sectors account only for a small proportion of private infrastructure investment, with far fewer projects.[7] Thus, between 2006 and 2015, the transport sector accounted for 1.2%, 5.4% and 0.0% of total PPP investment in least developed countries, landlocked developing countries and small island developing States, respectively, while it represented more than one-fourth in other developing economies in the region. The small PPP track record in the transport sector in CSN could be because transport infrastructure, especially roads, is typically considered as domestic public assets and financed locally on a standalone basis.

However, at the country level, the degree of private sector engagement varies widely across the CSN, with the Lao People's Democratic Republic standing out by receiving PPP investment equivalent, on average, to 18.6% of GDP every year between 2006 and 2015. This was largely due to investment in hydropower projects (figure 3.8). Armenia, Bhutan, Cambodia, Nepal and Tajikistan also received investment predominantly in the energy sector. In contrast, the majority of the CSN received less than 1% of their GDP in private infrastructure investment, and most of such investments were for ICT infrastructure.

Involving the private sector has a number of benefits other than financing.[8] For example, the introduction of private sector technology and good governance in business practices can help realize infrastructure projects and enhance project quality, with improved transparency and accountability. By transferring risks to the private sector, government finances can be protected against potential cost overruns that are often significant in public infrastructure projects in CSN.

In CSN, however, the possibility of enhancing private sector engagement has been limited due to investor-unfriendly environments. High risks associated with politics, currency and other macroeconomic situations in CSN dilute investors' interest, making it difficult to engage the private sector in infrastructure projects. In some CSN, economic returns are simply too low to attract investment because of the small size and low density of population and/or their geographic isolation. In addition, underdeveloped domestic capital markets

Figure 3.8. PPP investment, by country and type of infrastructure, 2006-2015, in percentage of GDP



Sources: ESCAP calculations based on data from the World Bank Private Participation in Infrastructure Project Database and ESCAP Statistical Database.
Note: See figure 3.6.

and inaccessibility to international capital markets limit options of borrowing money or issuing bonds or equities to embark on large infrastructure projects. A later section in this chapter provides a more detailed discussion on the challenges and opportunities for further private sector engagement for CSN.

3. Development cooperation for infrastructure financing

There are tremendous opportunities and potential for development partners to support CSN in infrastructure financing. At the same time, it is clear that to meet the acute need of CSN for infrastructure, more ODA, including aid for trade, and Other Official Flows (OOF) are required beyond domestic resources.[9]

ODA already provides budgetary support to domestic public expenditure in Asia-Pacific CSN, particularly in least developed countries. CSN as a whole received bilateral ODA exceeding $10 billion every year over the past five years from OECD-DAC member countries, of which more than 80% was directed to least developed countries.[10] However, the share of ODA to GDP declined from 2.9% in 2002 to 1.4% in 2014 (figure 3.9). This downward trend is particularly noticeable for landlocked developing countries (from 1.9% to 0.3%) and for small island developing States (from 7% to 3.6%), while the share has leveled at around 4% of GDP for least developed countries during the same period.

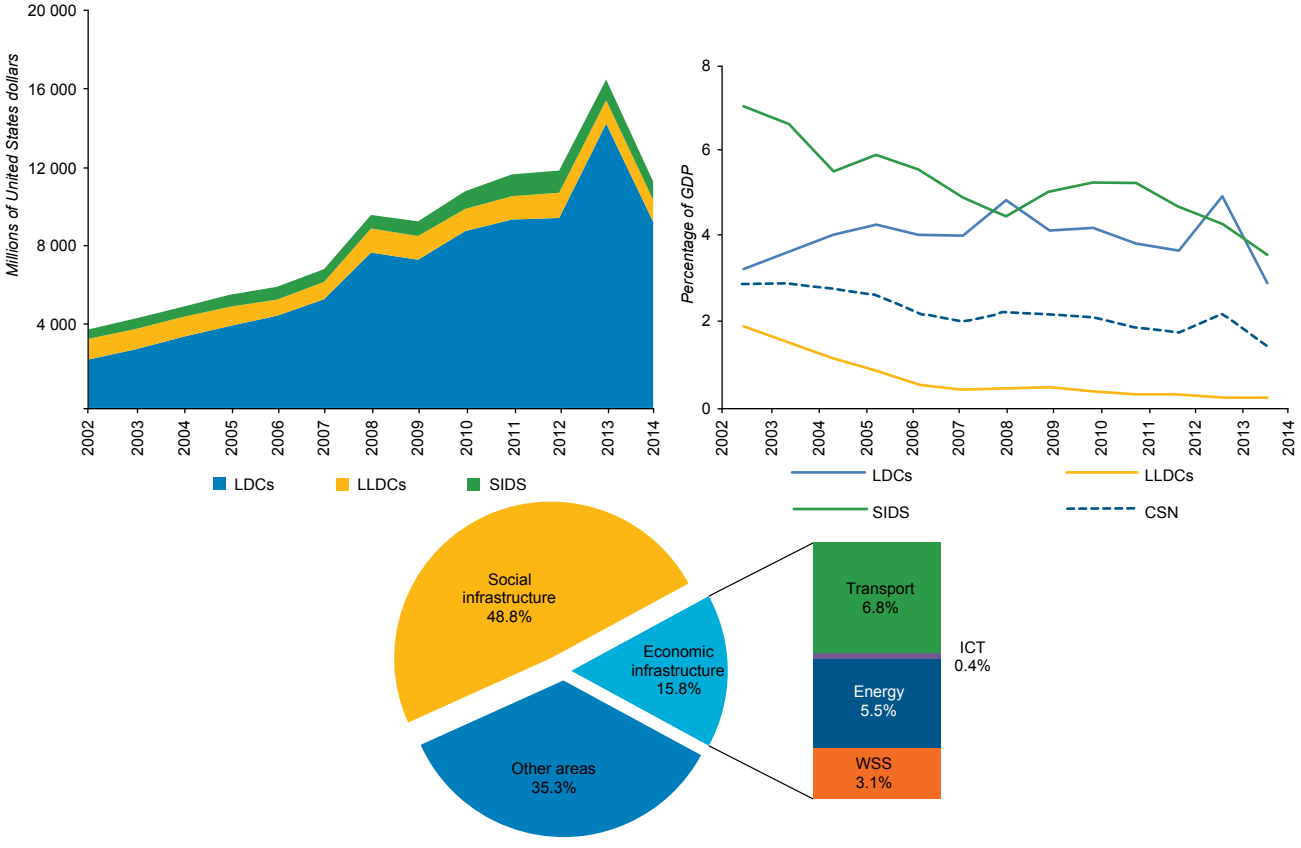
In terms of composition, nearly half of ODA from OECD-DAC to CSN went to the social sectors and institutions to strengthen capacities, systems and policies, while 15.8% was spent on economic infrastructure, primarily transport (6.8% of total), followed closely by the energy (5.5%) and WSS sectors (3.1%). ICT development accounted for only 0.4% of total ODA.

However, the share of ODA to transport has been declining in recent years, especially in least developed countries and small island developing States, whereas that directed to energy has been on the rise. For landlocked developing countries, the energy sector accounted for nearly a half of economic infrastructure ODA during 2010-2014 (figure 3.10).

Non-DAC donors have also undertaken South-South cooperation activities and provided financial resources to CSN, although the available data are not as complete as that for DAC counterparts. Thus, gross concessional flows for development cooperation ("ODA-like" flows) from six non-DAC Asian countries (Turkey, China, India, the Russian Federation, Thailand and Indonesia) almost doubled from $4.7 billion in 2010 to $9.3 billion in 2014, about one-quarter of which was received by CSN.[11]

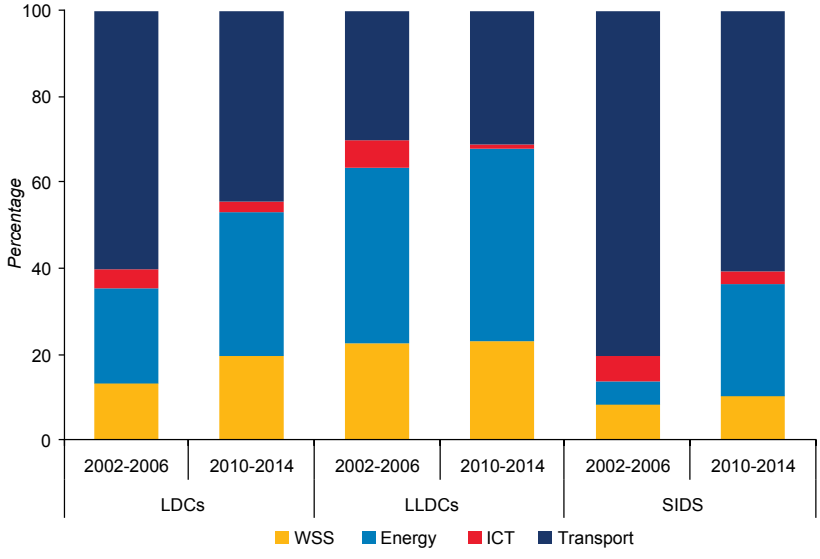
Another official financial source of growing importance is OOF through national development financial institutions and export credit agencies. These entities provide government-backed loans, guarantees and insurance to

Figure 3.9. Bilateral ODA from OECD-DAC to Asia-Pacific least developed countries, landlocked developing countries and small island developing States, 2002-2014 (average of 2010-2014)



Sources: ESCAP calculations based on data from OECD International Development Statistics, available at http://stats.oecd.org/qwids/ (accessed 7 November 2016), and the ESCAP Statistical Database, available at http://www.unescap.org/stat/data/ (accessed 7 November 2016).

Figure 3.10. Composition of economic infrastructure ODA from OECD-DAC to Asia-Pacific least developed countries, landlocked developing countries and small island developing States, 2002-2006 versus 2010-2014



Sources: ESCAP calculations based on data from OECD International Development Statistics, available from http://stats.oecd.org/qwids/ (accessed 7 November 2016).

companies from their home country looking to do business in host countries and usually stipulate that materials, machines and sometimes labour for infrastructure projects are bought from their home countries (Ehlers, 2014).[12] Their involvement is important as it may provide reassurance to other lenders who may not have the necessary expertise and monitoring capabilities to gauge political risks.

Other Official Flows from OECD-DAC to CSN, which is quite limited, reached $400 million in 2014 – equivalent to less than 3% of bilateral ODA – with even smaller shares directed towards infrastructure. In sharp contrast, the majority of official flows from non-DAC countries is provided in the form of OOF. It is estimated, for example, China's OOF would be three to five times larger than its ODA, depending upon how Chinese development assistance is defined and perceived.

Given the significant shortage of available infrastructure, and in view of the increasing demand for infrastructure services in CSN as well as the limited fiscal space of both CSN and development partners, development assistance through ODA and OOF will continue to be a vital source of external finance. This is particularly the case with the poorest Asia-Pacific countries, which rely heavily on development assistance for financing infrastructure development.[13] The involvement of new actors has certainly been instrumental in many of the infrastructure projects that have taken place in Asia and the Pacific.

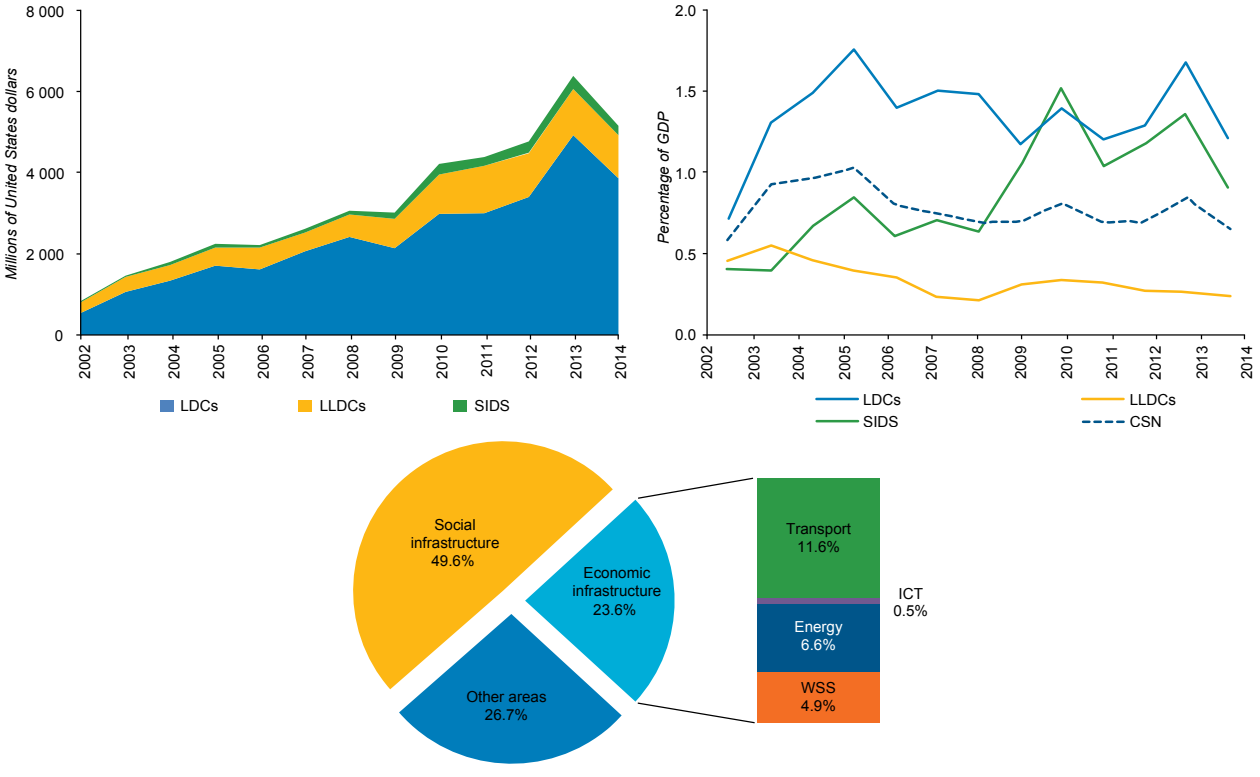
4. International and regional finance institutions

(a) Multilateral agencies

In addition to bilateral ODA and OOFs, development assistance through multilateral agencies, including multilateral development banks (MDBs) and the United Nations funding and agencies, are essential for CSN, particularly those with limited access to capital markets to support the financing of infrastructure projects. These multilateral agencies provide loans and grants to Governments or public sector entities, and issue risk guarantees and project insurance against risks.

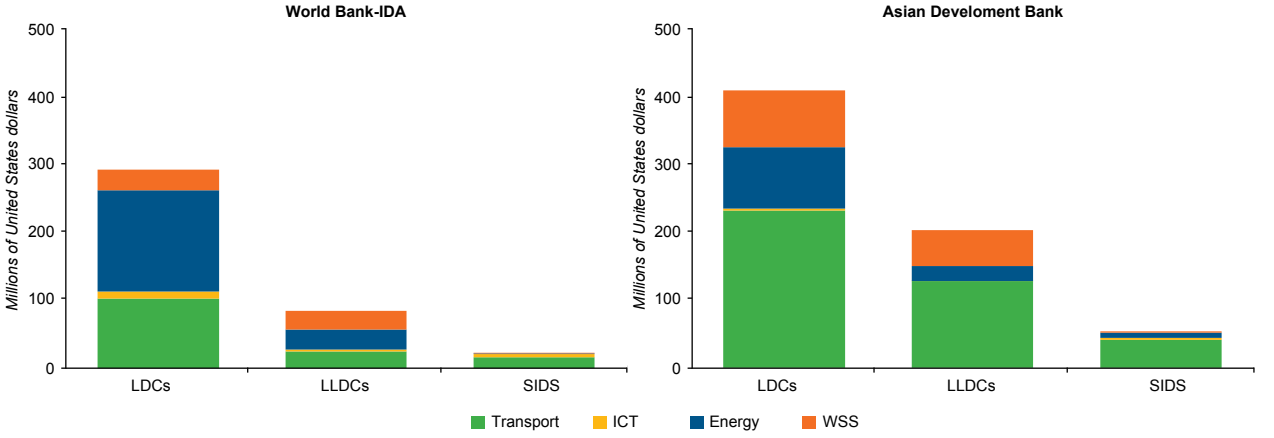
Between 2010 and 2014, an average of $5 billion was provided annually as ODA from multilateral agencies to CSN (figure 3.11). As a proportion of GDP, least

Figure 3.11. Development assistance from multilateral agencies to Asia-Pacific least developed countries, landlocked developing countries and small island developing States, 2002-2014 (average of 2010-2014)



Sources: ESCAP calculations based on data from OECD International Development Statistics, available from http://stats.oecd.org/qwids/ (accessed 7 November 2016) and ESCAP Statistical Database, available from http://www.unescap.org/stat/data/ (accessed 7 November 2016).

Figure 3.12. Composition of development assistance for economic infrastructure financing from the World Bank and Asian Development Bank to CSN, average of 2010-2014



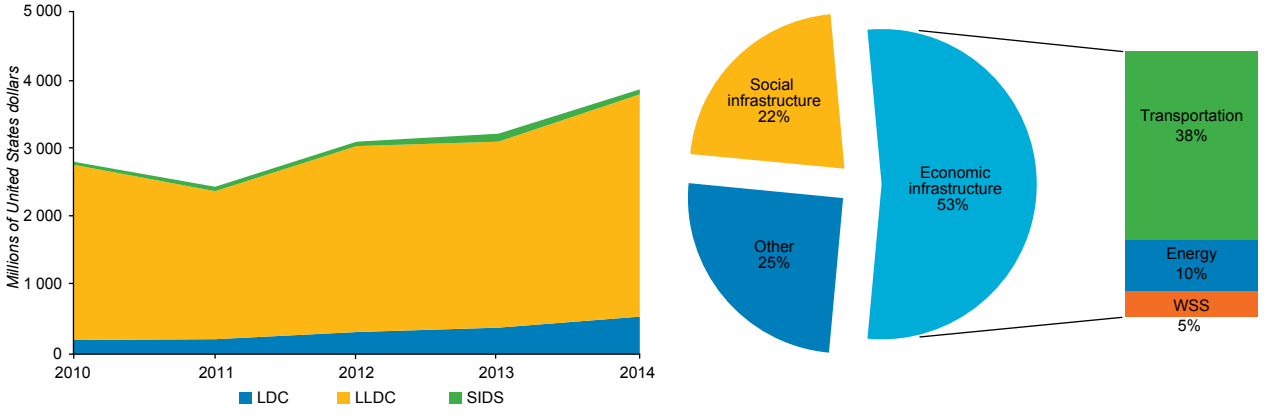
Sources: ESCAP calculations based on data from OECD International Development Statistics, available at http://stats.oecd.org/qwids/ (accessed 7 November 2016).

developed countries and small island developing States received more than 1% of their respective GDP (1.4% for least developed countries and 1.2% for small island developing States), while ODA from those agencies to landlocked developing countries and other developing countries were rather limited with only 0.3% of GDP. Of this amount, $1.2 billion (approximately 23.6%) was directed towards economic infrastructure, such as transport, energy, WSS and ICT, with transport being a key area of intervention (11.6%), followed by energy (6.6%) and WSS (4.9%).

Among various multilateral agencies, two MDBs, the World Bank and the Asian Development Bank (ADB), provide nearly two-thirds of such development assistance for the period 2010-2014. The contributions from the two MDBs have been more or less equally distributed by them for least developed countries, landlocked developing countries and small island developing States. However, there is a notable difference in the way the two banks provide support to CSN. While the World Bank directed 28% of its total ODA to CSN for financing economic infrastructure development, the respective proportion of ADB was twice as large, reaching 60%. In addition, almost half (45%) of World Bank funding went to the energy sector whereas the transport sector (60%) dominates the funding of ADB. In addition, ADB has a relatively strong focus on WSS-related infrastructure (figure 3.12).

While the majority of funding has been channelled in the form concessional loans and grants, multilateral agencies have also provided a significant amount of resources (more than $3 billion) as OOF to financially support infrastructure projects in CSN. The main beneficiaries are landlocked developing countries, especially in their transport sector (figure 3.13).

Figure 3.13. Evolution and composition of OOF from multilateral agencies to Asia-Pacific CSN, 2010-2014



Sources: ESCAP calculations based on data from OECD International Development Statistics, available at http://stats.oecd.org/qwids/ (accessed 7 November 2016).

Nevertheless, financial resources from multilateral agencies, which alone cannot be the sole financing source of infrastructure development, constitute about 10% of infrastructure investment in CSN. Rather, their involvement might attract capital from the private sector by enhancing confidence and reducing risk premiums for infrastructure projects. MDBs thus act as independent mediators between public and private parties and have the ability to promote policies that improve the investment climate or mitigate sudden changes in policies.

(b) New regional initiatives

New regional initiatives and infrastructure funds are increasingly being recognized as important for infrastructure development in CSN and beyond. Examples include: (a) the Asian Infrastructure Investment Bank (AIIB), the ASEAN Infrastructure Fund and the New Development Bank (NDB), which provide a variety of forms of investment and financing, but primarily through loans; and (b) the Global Infrastructure Facility, the Asia Pacific Project Preparation Facility and the Pacific Regional Infrastructure Facility (PRIF), which primarily function as facilitators or coordinators for investors of infrastructure development. Since CSN typically lack a local investor base, the involvement of such new initiatives may be decisive for international investors entering their markets.

The newly-established AIIB is a multilateral financial institution that aims to support infrastructure development in the Asia-Pacific region. It is considered an important source of infrastructure financing under the China-led Belt and Road Initiative (BRI) (box 3.3). Since becoming operational in December 2015, AIIB loans totalling more than $1.73 billion have already been approved, of which $813 million have been pledged for infrastructure projects in CSN.[14] Overall, AIIB is expected to lend between $10 billion and $15 billion annually during the next five to six years (Kumar, 2016).

Of the seven projects that have been approved or proposed for CSN, five are related to electricity production or distribution capacity, reflecting the fact that CSN have significant bottlenecks in the power sector due to low electrification rates and poor quality of supply. Thus, a project to enhance distribution capacity and increase energy access in rural and urban areas in Bangladesh was one of the first approved AIIB projects; since then, a 225-megawatt combined cycle gas turbine power plant project has been approved in Myanmar, while additional projects are aimed at enhancing transport connectivity of landlocked developing countries.

The ASEAN Infrastructure Fund is a dedicated fund established by ADB and ASEAN to address the ASEAN region's infrastructure investment needs. It aims to provide loans of around $300 million per year to finance projects in the transport, energy, water and sanitation, environment and rural development, and social infrastructure sectors by mobilizing regional savings, including foreign exchange reserves. To date, the Fund has processed seven projects, including two projects in CSN – one for road improvement in Myanmar and the other for electricity distribution in the Lao People's Democratic Republic.[15]

The New Development Bank (NDB), formally referred to as the BRICS Development Bank, is a multilateral development institution established in 2015 by the BRICS countries (Brazil, China, India, South Africa and the Russian Federation). NDB provides support to both public and private projects through loans, guarantees and equity participation, with priority given to developing renewable energy sources. NDB had approved seven investment projects worth $1.5 billion in the BRICS countries by the end of 2016.

The World Bank's Global Infrastructure Facility is a global platform that facilitates the preparation and structuring of infrastructure PPP projects. It aims to mobilize private sector and institutional investor capital by building a pipeline of sustainable infrastructure investment projects and fostering collaboration on complex projects that no single institution can achieve alone. Projects under preparation include the Tina River Hydroelectric Development Project for Solomon Islands, which aims to supply much-needed electricity to Honiara, the capital city of the island State. Although it is still in the pilot phase with an initial capitalization of $100 million, with their private sector partners representing about $12 trillion in assets under management, it has large potential for unlocking billions of United States dollars for infrastructure in CSN.

The ADB Asia Pacific Project Preparation Facility is a new, multi-donor umbrella facility that aims to encourage private sector participation in infrastructure development and to place bankable PPP projects in the market.

The Pacific Regional Infrastructure Facility provides a mechanism for infrastructure financing that blends loans, grants and technical assistance. It was established in 2008 as a multi-development partnership for creating better infrastructure in Pacific island countries and it has played a vital role in coordinating infrastructure development in the Pacific. The facility offers advisory services for sector planning, policy, regulatory and institutional reforms, capacity development and brokerage of investment activities. The majority of infrastructure projects that are supported by the facility are in the energy sector, followed by transport and WSS.

Box 3.3. Benefits and potential risks of China-led Belt and Road Initiative

The China-led Belt and Road Initiative (BRI) is a development strategy and framework, proposed by China in 2013, to establish a network of regional infrastructure to promote trade, investment, and economic integration. Several financial institutions, including AIIB, NDB and the Silk Road Fund[a], are expected to contribute to the initiative. This initiative will not only promote international trade and investment in the region but also facilitate the exchange of ideas and culture, accelerate regional economic integration, and eventually promote regional economic development and improve the people's lives. However, as infrastructure development requires significant resources and does not always provide a sufficient return to investors, it is important for countries involved to work closely to maximize the benefits and minimize the risks.

Benefits to CSN

The CSN can benefit from BRI through multiple channels. First, the BRI will help infrastructure development in the CSN by providing financial assistance. By participating in the BRI, CSN can obtain foreign capital and expedite infrastructure construction. Projects initiated in CSN are all infrastructure-related projects. For example, approved projects by AIIB, the Dushanbe-Uzbekistan Border Road Improvement Project in Tajikistan and the Power Plant Project in Myanmar as well as the proposed Trans Anatolian Natural Gas Pipeline Project in Azerbaijan and the Center South Road Corridor Project in Kazakhstan are all large-scale infrastructure projects.

Second, the BRI promotes international trade between CSN and other countries, including China, and can contribute to accelerating regional economic integration. With better transportation infrastructures, it is easier for CSN to export to other countries and to import with lower transport costs. For example, transportation infrastructure related to the China-Mongolia-Russia Economic Corridor (CMREC) would benefit Mongolia's exports.

Third, infrastructure development through FDI generates externalities in the form of technology transfers, creates spillover effects, and also adds to the capital stock. Infrastructure development in CSN also increases employment in those countries and has forward and backward linkages, stimulating investment in related service industries, manufacturing industries and resource industries.

Fourth, infrastructure improves living standards in CSN. For example, better transportation infrastructure facilitates travel from one region to another inside the country as well as to other parts of world.

Finally, the benefits of the BRI, which include increased investment trade, employment and technology spillovers, will accelerate economic growth in CSN, thereby lifting people out of poverty. Faster economic growth, poverty reduction and improvement of living standards in the region also helps to reduce regional instability.

Potential risks for CSN

Despite these multiple benefits, however, the BRI may bring about some potential risks to CSN. The BRI initiative may increase pollution as infrastructure development proceeds. In addition, hydroelectric power generation carries environmental risks; while hydroelectric power provides renewable energy for economic development, hydroelectric reservoirs destroy forests, wildlife habitats, agricultural land, scenic land and aquatic ecosystems.

Infrastructure development associated with the BRI may also increase foreign debt as CSN need to borrow from financial institutions. This is a concern for CSN that already have high levels of debt. For instance, in 2015, the foreign debt-GDP ratio was 86% in the Lao People's Democratic Republic, 84% in Kazakhstan, 95% in Azerbaijan, and 153% in Mongolia.

Moreover, large-scale infrastructure projects may contribute to de-industrialization in CSN, as greater connectivity to China may induce large inflows of Chinese exports, such that developing countries along the BRI corridors may experience a decline in industrial production (Ahmad, 2016). While international trade and investment may increase the income of some groups of people, it may also cause unemployment and a decline of income among others, thereby contributing to greater levels of income inequality.

Maximizing benefits and minimizing risks

It is important to conduct thorough cost-benefit analyses for infrastructure projects. For business firms involved, explicit and implicit benefits and costs must be considered, spanning both in the short term and the long term. For Governments, private and social returns and costs must be considered. Since externalities will inevitably emerge together with infrastructure development, Governments involved in the BRI must be prepared to provide fiscal subsidies.

International coordination is also crucial. Many of the infrastructure projects involve countries with different languages, cultures, and economic and legal systems. Communication is important and the parties involved should share information. Moreover, it is important to devise appropriate operational plans for projects by ensuring that they are well-designed, well-constructed and meet environmental requirements.

Source: Lin (2017).

[a] The Silk Road Fund is a stated-owned investment fund of China, established in 2014, to support the BRI but primarily serves as an equity investor for medium to long-term development projects. While it has total capital of $40 billion, with investment from the State Administration of Foreign Exchange, China Investment Corporation, Export-Import Bank of China and China Development Bank, it has not, however, yet announced any infrastructure development projects in CSN.

Accessing larger-scale resources as described above requires strong national institutions as well as the ability to structure and develop projects that can take advantage of loans, equity and guarantees. It should be noted, however, that the amount that new regional initiatives and infrastructure funds are providing, with the total approved investment of only $1 billion for CSN, remains limited compared with the overall investment financing needs faced by CSN. Similar to the roles of existing multilateral agencies and development banks, the key contribution to infrastructure development in CSN would be through additional values that they can bring in attracting private sector investment by improving project design and structure, lowering transaction costs, risks and risk perception, promoting policy and institutional reforms, and providing knowledge solutions (ADB, 2017).

B. NEW FINANCING VEHICLES AND MECHANISMS

While loans and grants from public sources will remain important modalities of finance in the short term, the CSN will have to find new financing vehicles and mechanisms to close the infrastructure gaps in the long term.

Institutional investors, including pension funds, insurance companies and sovereign wealth funds, have the potential to step in and finance long-term infrastructure projects. In practice, however, the risk profile of infrastructure projects is not acceptable by them to serve as direct investors; this is particularly the case with CSN where projects are perceived to have a high exposure to country risk associated with underlying information asymmetries and the inherent complexity of infrastructure assets. Equity participation may be an available option in several high-income landlocked developing countries, while in most CSN the deepening of local capital markets is a precondition for any significant development in this regard. To date, only a limited share of assets has been invested in infrastructure development globally, and very few institutional investors have been structured to meet their financial requirements in CSN (See, for example, Della Croce, 2012). Indeed, even in OECD member countries portfolio allocations of pension funds to infrastructure debt and equity are small, standing at around 0.5% of total assets of pension funds and public pension reserve funds of $5 trillion in 2012.

The Green Climate Fund is a financing mechanism created in 2010 under the United Nations Framework Convention on Climate Change to support a paradigm shift in the global response to climate change through (a) building climate-resilient infrastructure and (b) increasing the resilience of vulnerable communities to climate-related risks. Its funding can be accessed by companies, organizations and funds seeking to achieve social and environmental impacts through a range of financial instruments, such as grants, loans, equity and guarantees. The fund pays particular attention to societies that are highly vulnerable to the effects of climate change, in particular least developed countries and small island developing States. Thus, at the end of 2016, a total of $10.3 billion had been pledged to cover investments in 27 projects during the next four- to five-year period. These initiatives included the establishment of new Sustainable Energy Financing Facilities, co-financed with the European Bank for Reconstruction and Development, with the aim of scaling up private sector climate finance in 10 target countries, including three CSN – Armenia, Mongolia and Tajikistan. The CSN are also beneficiaries of six small- and medium-scale projects with a total grant amount of $170 million.[16]

Green bonds are debt instruments for raising financial resources from markets for "green" projects such as construction of low-carbon energy infrastructure and climate-resilience transport systems. Although there is no explicit financial advantage to be gained by labelling a bond as "green", it may be able to attract environmentally conscious investors if a proper labelling system and regulatory standards are put in place. These bonds can be issued by public entities, multilateral banks as well as private companies and financed by a broad spectrum of investors, including institutional investors. Green bonds are more relevant to countries that have a strong financial system, although it is possible for multilateral agencies to use such instruments in emerging and more advanced markets to support infrastructure investments in CSN (ESCAP, 2017c).

The European Investment Bank has been the largest issuer of green bonds, providing more than $17 billion equivalent in its "Climate Awareness Bonds" that have been allocated to 145 projects in 47 countries between 2007 and the first half of 2016 (Climate Bonds Initiatives, 2016).[17] However, to date, CSN have not been beneficiaries of these projects.

The World Bank is also a major issuer of green bonds, having allotted more than $9.7 billion equivalent in green bonds through more than 125 transactions in 18 currencies, supporting a total of 85 projects, since its inaugural issue in 2008.[18] The vast majority of these projects have supported large developing countries such as Brazil, China, India and Indonesia. Only three CSN – Armenia, Timor-Leste and Uzbekistan – have benefitted from loan financing raised through the World Bank green bonds, with a total loan amount of $218 million.

ADB also started issuing green bonds in 2015 to promote low-carbon and climate-resilient economic growth and development in developing Asia and the Pacific. Since then, ADB has approved more than 50 green bond-eligible projects totalling a loan amount of $3.2 billion. CSN are beneficiaries of 10 projects with a total loan amount of $795 million.[19]

In some developing countries, excess foreign exchange reserves are seen as potential sources of development finance, especially in the social sector and infrastructure.[20] The use of excess foreign exchange reserves for infrastructure development is not new. India has pioneered mobilization of some of its foreign reserves for infrastructure development through a special purpose vehicle, the India Infrastructure Finance Co. Ltd. This company issues foreign currency denominated bonds for investment by the Reserve Bank of India, and the funds thus raised are utilized for lending to the companies implementing infrastructure projects (Kumar, 2016). Other emerging economies of the region, such as China, Republic of Korea and Singapore, have been also using part of their foreign exchange reserves for economic investments.

Among the monetary authorities of the CSN, Bangladesh Bank may become one of the first to use foreign exchange reserves for infrastructure financing.[21] Bangladesh Bank had proposed in the past that its Government tap the bank's growing foreign reserves for infrastructure development projects, such as the construction of Padma Bridge, the largest- ever physical infrastructure project in the country. However, reserves were not used to finance those projects due to concern over a mismatch between revenue income and expenditure. Indeed, given that many CSN face foreign exchange constraints, using reserves may not be viable option for them, given that infrastructure development is a longer-term undertaking while liquidity is a prime concern of reserves. Bangladesh Bank is thus considering setting up a sovereign wealth fund created with foreign exchange reserves, which would issue bonds to raise money from the market in local currency to finance mega-infrastructure projects. It also plans to use foreign exchange reserves for investing in green bonds (Yu, 2017). Under this scheme, Bangladesh Bank will provide funds to financial institutions at 5% to enable them to reduce interest rates to 6%-7% when lending for renewable energy projects.

Islamic finance has the potential to become one of the innovative sources of financing for infrastructure projects. Its banking segment has rapidly grown globally during the past decade, with potential for increasing the sector in several of the CSN, including Afghanistan and Bangladesh. The defining principle of Islamic banking prohibits the charging and paying of interest, but promotes profit-sharing mechanisms. Therefore, by developing innovative profit-sharing frameworks, this financing mechanism can provide investors with new instruments that minimize risks in long-term investments.

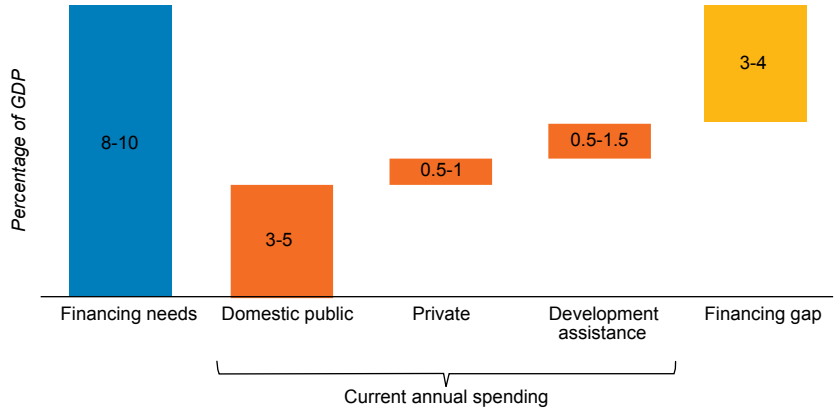
Many of these new financing vehicles and mechanisms have potential to deliver new sources of finance for CSN. Especially climate finance tools and green bonds can provide financing sources for renewable energy infrastructure development in small island developing States, and for development of climate-resilient transport infrastructure in least developed countries and landlocked developing countries. It should be noted, however, that the development of local capital markets is necessary for CSN to take full advantage of these new opportunities. For example, institutional investors such as pension funds and insurance companies will have no mechanism to channel their substantial savings into infrastructure investment without well-established capital markets and a stable institutional environment. Similarly, green bonds are often created through the securitization of project finance loans in local bond markets. Thus, a high priority should be placed on developing equity and debt capital markets, while public authorities need to develop a pipeline of projects that are in line with the objectives of new partners and mechanisms, with a combination of proper institutions and capacities to manage information asymmetries.

The CSN can also benefit from co-financing arranged among multilateral development banks as well as national development banks and development finance institutions. Indeed, co-financing already has a well-established track record in catalyzing infrastructure financing flows from the private sector. In particular, MDBs already have a long history of working together with national development banks, development finance institutions and expert credit agencies to provide infrastructure financing, with co-financing by private sector institutions.

C. INFRASTRUCTURE FINANCING CHALLENGES FOR COUNTRIES WITH SPECIAL NEEDS

As discussed in the previous section, current levels of infrastructure funding fall far short of the financing needs of 8%-10% of GDP per year in CSN (figure 3.14). While this fact underscores the importance of an effective, efficient and more catalytic use of existing funds, many CSN face a challenge, both in terms of delivering public services and raising additional financial resources.

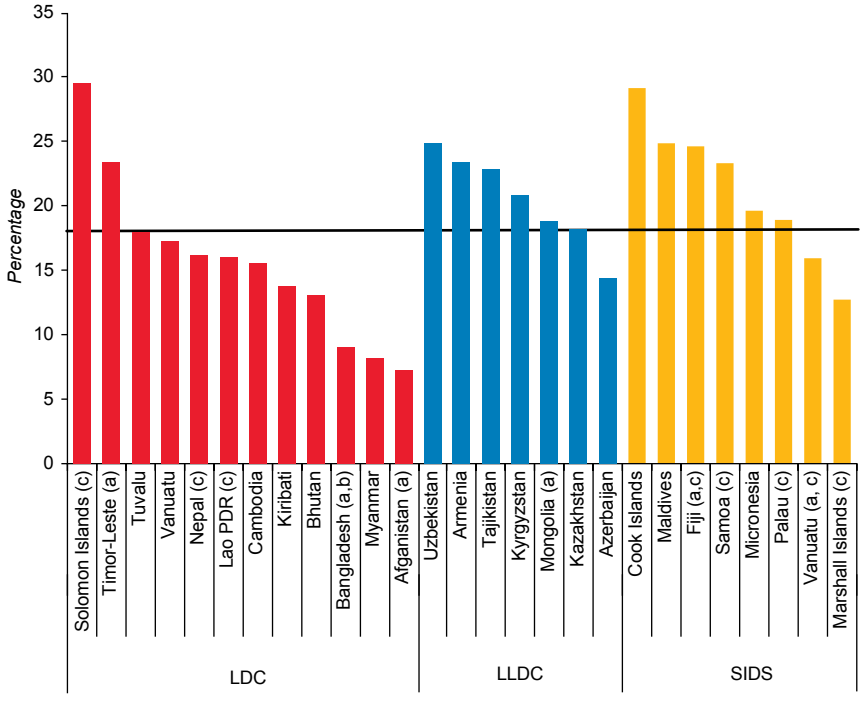
Figure 3.14. Current levels of infrastructure spending and financing needs in countries with special needs



Source: ESCAP.

Public sectors suffer from low efficiency in delivering public services and generating economic growth through infrastructure. On the revenue side, the collection of tax is low in many CSN (figure 3.15). While a rule of thumb for the financing required for the Millennium Development Goals was a tax-to-GDP ratio of about 18% in developing countries, 13 out of 27 CSN for which relevant data are available had tax-to-GDP ratios below that level in 2014. These low levels of tax revenue in CSN are partly due to the fact that a large proportion

Figure 3.15. Tax-to-GDP ratios in selected Asia-Pacific countries, 2014



Sources: ESCAP compilation based on data from IMF Government Finance Statistics, available at data.imf.org/gfs (accessed 16 November 2016); and IMF Article IV Consultation Reports.

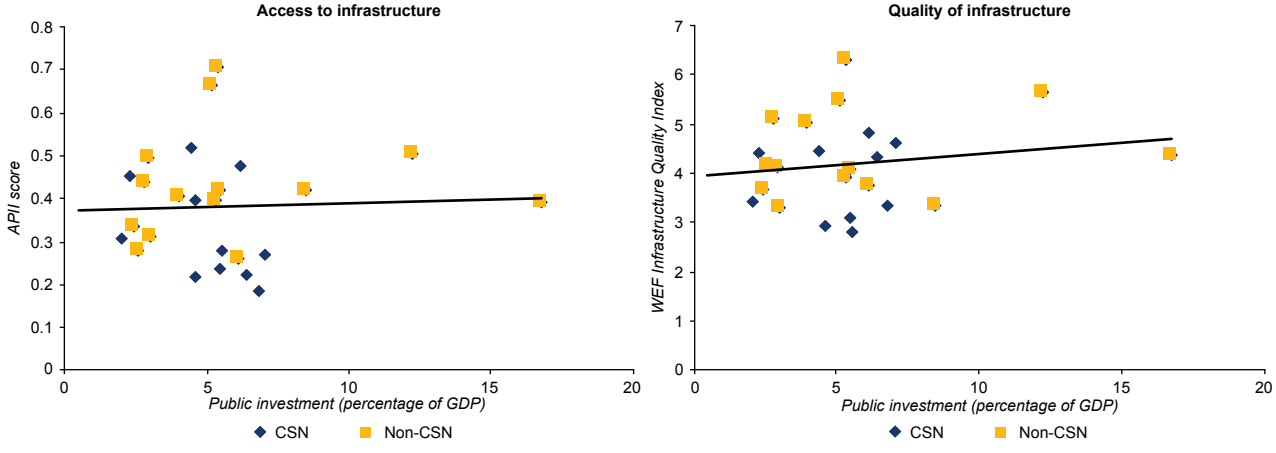
Note: The figures refer to general government tax revenue as a share of GDP unless otherwise stated. Data include estimates.
(a) Data are for 2013.
(b) Refers to central Government tax revenue.
(c) Refers to budgetary central Government tax revenue.

of the labour force is employed in the informal sector or in agriculture, neither of which are susceptible to income taxes. In addition, tax avoidance and evasion, particularly by wealthier individuals, is also a problem. In Bangladesh, for example, only about 1% of the population pays income tax (ESCAP, 2015b). Shortfalls in revenue targets are often accompanied by cuts in infrastructure spending, particularly in countries that have chronically weak public revenue such as CSN. Cuts on maintenance spending are less noticeable, but could lead to quicker depreciation of existing infrastructure assets and result in costly reconstruction or repair jobs. Therefore, the tax-to-GDP ratios of CSN will need to rise sufficiently to cover the provision of basic infrastructure, operations and maintenance spending.

Inefficiency in delivering public services may also arise from poor public expenditure management. In the CSN, public investment in infrastructure may not be necessarily linked with improved infrastructure access or service quality. For example, Governments often use a range of tax concessions to encourage investment in infrastructure, while they do not always effectively target intended beneficiaries and may perpetuate reliance on high carbon or outdated technologies (ESCAP, ADB and UNDP, 2017). Figure 3.16 shows the relationships of public investment with access to physical infrastructure and with quality of infrastructure. The weak correlations shown in both panels (particularly for CSN) suggesting that public investment does not translate into improving infrastructure services, implies that there is considerable scope to enhance the efficiency of public investment in CSN. Indeed, IMF (2015) estimated that around 30% of potential gains from public investment are lost due to inefficiencies in public investment processes. Similarly, delays and cost overruns due to weak institutional capacities and planning inefficiencies cost between 20%-50% of total infrastructure projects costs, according to Bhattacharya, Oppenheim and Stern (2015). In this context, institutional reforms for better public investment management may be critical to enhancing public infrastructure quality and economic growth. Governance is an important aspect of ensuring that public expenditure is effective and efficient (ESCAP, 2017c).

Private sector engagement has been severely hampered as the risk-return profile of many infrastructure projects is not usually aligned with the incentives of private investors. Tapping private resources and expertise in providing infrastructure requires certain conditions. For example, private investors will only invest when there are positive cash flows and the risk-adjusted returns are competitive with alternative investment opportunities. In this context, energy infrastructure, ICT infrastructure or certain types transport infrastructure, such as toll roads, railways or airports, have room for private financing as these sectors generate cash flows through operating activities.[22] In contrast, social infrastructure and WSS infrastructure are largely financed by public sources in CSN as they are not likely to produce positive financial returns unless Governments subsidize private operators for delivering the services. Since there is little room to increase tariffs for water to ensure that it is affordable for the poor in CSN, the gap between affordable tariffs and cost recovery needs to be covered by public funds.

Figure 3.16. Public investment and infrastructure quality



Sources: ESCAP calculation based on data from IMF Investment and Capital Stock Dataset, Fiscal Affairs Department, International Monetary Fund, available at www.imf.org/external/np/fad/publicinvestment/data/data.xlsx (accessed 7 November 2016); World Economic Forum Global Competitiveness Index, available at http://reports.weforum.org/global-competitiveness-report-2014-2015/rankings/ (accessed 7 November 2016); and ESCAP Statistical Database, available at http://www.unescap.org/stat/data/ (accessed 7 November 2016).

Notes: The APII is a composite index for measuring the accessibility to physical infrastructure. The APII scores used in this figure are three-year averages between 2013 and 2015. Chapter 2 and anex II provide details of the APII. The World Economic Forum infrastructure quality index is for 2014-2015 and is on a scale of 1 to 7, with 1 being underdeveloped and 7 being well-developed. Public investment is measured by annual public fixed capital formation as a share of GDP, averaged over 10 years leading to 2014.

Even in sectors where higher economic returns can be expected, there are always non-economically viable areas of countries, mostly the rural communities or isolated outer islands. For example, several missing fibre-optic links in CSN are due to the fact that the unconnected areas are not profitable for ICT infrastructure investment. There have been attempts to tackle this challenge by Governments, including subsidizing of rural areas by profitable urban areas (cross-subsidization) and covering gaps between toll collections and operation (viability gap funding). Partnering with international donors such as the World Bank and ADB can also increase financial viability of projects by financing and risk management instruments, including viability gap funds, and by reducing operational inefficiencies and ensuring enhanced transparency and sound practices.

Private sector participation also requires good governance, i.e., fairness, transparency, accountability, sustainability, effectiveness and efficiency. Given that political risk is a great concern of private investors, many CSN are still unequipped to engage in PPP arrangements. Furthermore, effective regulation is required in order to avoid PPP for public service delivery increasing inequality, e.g., by neglecting rural consumers (UN-OHRLLS, 2014). Since, in many cases, infrastructure investment from the private sector cannot be realized without some form of public support, Governments need to carefully consider these factors in identifying ways to finance infrastructure projects as well as match the type of financing instrument for each infrastructure subsector.

Private sector infrastructure investment can be facilitated by government initiatives in preparing projects for investors by undertaking feasibility studies, preparing priority lists of infrastructure projects, providing necessary government project approvals and other steps to ensure that the projects are ready for private sector investment. The establishment of an infrastructure project pipeline can also be enhanced by better coordination among government agencies in order to accelerate the timeframe for obtaining the necessary project approvals. Consultation mechanisms between the public and private sectors may also help to improve the infrastructure approval process.

Innovative PPP can also facilitate processes to address finance gaps in infrastructure in CSN and generate returns for the private sector. For example, the construction of a dual-purpose storm water management and road tunnel project in Kuala Lumpur, Malaysia, utilized an innovative way of PPP and solved the problem of flash floods as well as reduced traffic jams in the city. Thus, by allowing a portion of the tunnel to be tolled for traffic, private sector participation in PPP could be secured, reducing the costs of the project for the Government, while the road functions as storm water drainage to capture the excess water during heavy rainfall events. Box 3.4 provides

Box 3.4. Financing sanitation infrastructure in Bangladesh

In Bangladesh, like many developing countries in Asia and the Pacific, rapid urbanization is creating an increasing strain on overburdened infrastructure as well as increasing the demand for basic services. In this regard, urban sanitation remains a major challenge as most households and buildings are not connected to any kind of sanitation system and, like many other developing countries in the region, depend on on-site technologies such as septic tanks and pit latrines. Currently, there is no formal and environmentally sound system of faecal sludge collection and treatment, such that untreated effluents are discharged into lakes, rivers and canals, causing pollution and health hazards. While sanitation is the responsibility of municipalities, they often lack the necessary funds as well as the organizational and technical capabilities to take up the role. In particular, municipalities have limited ability to raise revenues for these types of infrastructure and services from taxes, making full cost recovery a real challenge.

In order to address this challenge, an attempt was made in Bangladesh to establish a viable financing and management system for faecal sludge management in the city of Kushtia. With the involvement of, and support from the Municipality of Kushtia and the Local Government Engineering Department of Bangladesh, an existing composting plant was upgraded in 2012 to be able to treat faecal sludge and transform it into fertilizer. The municipality set up a collection system for faecal sludge, charging 350 Bangladeshi taka ($4.50) per pit latrine and 500 taka ($6.43) for a larger septic tank. These fees, coupled with the sale of compost, are able to offset the operational costs of collection and treatment of the faecal sludge.

Based on the positive results from the project, and in the light of the urgent need to enable municipalities to raise the necessary financing for providing such services, the Ministry of Local Government of Bangladesh in late 2014 approved the application of a 12% property tax by municipalities for the purpose of financing faecal sludge collection and treatment. This measure is expected to greatly facilitate the replication of this and other successful practices.

Source: ESCAP (2016c).

another example of innovative partnerships for financing sanitation infrastructure in Bangladesh.

Nevertheless, the ability of CSN to utilize various forms of private sector financing does vary greatly, according to the economic size of the nation as well as the various stages of economic development attained. Therefore, there cannot be a "one-size-fits-all" approach to development financing, and the individual financing approaches for each nation need to be assessed on a case-by-case basis, finding pragmatic solutions to what is best suited to the financing capacity of a nation. This is particularly important when considering the financing needs of CSN as some of them have relatively small populations and weak capacity for raising finance through domestic capital markets. Box 3.5 offers policy alternatives for Samoa to illustrate the importance of country-specific needs and approaches to infrastructure financing.

Box 3.5. Infrastructure financing strategies for Samoa

Infrastructure needs in Samoa have been mainly financed through external assistance, with 70% of grants and 87% of loans allocated for this purpose. With Samoa's graduation from least developed country status and transition to an upper-middle income country, alternative sources should be developed to compensate for possible declines in development assistance in the future. The following policy alternatives have been put forward as ways to address this concern.

Improving public expenditure efficiency. A substantial portion of public expenditure is allocated towards infrastructure. Therefore, ongoing efforts to improve Public Finance Management systems are bound to have a positive impact on infrastructure development. In addition, Samoa has developed a strong infrastructure planning process with a National Strategic Infrastructure Plan, Sector Plans and Medium Term Expenditures Frameworks and a Public Sector Investment Plan. This planning process is necessary to ensure that the limited resources are allocated to projects aligned with national priorities, and that sufficient funding is devoted to asset maintenance. The challenge is now to implement these plans and coordinate the different agencies and other stakeholders involved in infrastructure projects.

Enhancing state-owned enterprises (SOEs) performance and accountability. SOEs such as the Electric Power Corporation, Samoa Water Authority and Land Transport Authority are active in infrastructure development. However, as their profitability is very low the Government is pushing ahead with reforms, given the potential impact of SOEs on fiscal sustainability. Contingent liabilities associated with SOEs operation comprise implicit guarantees of around 17% of GDP.

Mobilizing domestic resources. While grants represent a significant part of public revenues (averaged around 10%), the vast majority is from taxes (about 80%). Taxes have increased substantially during the past few years (+22% between 2012 and 2015) and the tax-to-GDP ratio is well above the Asia-Pacific average. Key reforms have been necessary to achieve these results, and fiscal policy continues to focus on reducing reliance on international trade-based taxes with the bulk of taxed revenue collected through Value-Added Goods and Services Tax and other taxes. These efforts are critical to generating more resources for public spending, including for infrastructure. In this regard, improving tax enforcement and compliance as well as effective and efficient revenue collection can make a significant difference.

Involving the private sector through PPPs. Private finance needs to complement public resources for infrastructure development. Samoa has experience with private finance in different sectors. For example, the Sogi Water Treatment Plan was developed through a five-year Design-Build-Operate-Transfer contract while power purchase agreements were signed to support private investment in power generation. To facilitate private sector involvement, the Government has put in place a PPP framework to guide the role of public, particularly SOEs, and private entities in developing bankable PPP projects as well as improving existing screening processes and the regulatory framework. A small PPP unit was also established in the Ministry of Public Enterprises.

Leveraging climate finance and ODA resources. The development finance landscape has changed in the past decade with the growing importance of climate-related instruments. Samoa has been relatively successful in seizing these opportunities with at least $109 million committed to date from these instruments. For example, Samoa was granted $8.7 million from the Adaptation Fund to enhance the resilience of coastal communities and $57.7 million from the Green Climate Fund for an integrated flood management system. To ensure the timely implementation of these projects, the absorptive capacities within the involved agencies need to be addressed as a matter of priority.

Source: ESCAP (2017c).

Future infrastructure investments have to be prioritized based on their environmental, social and economic sustainability, while the private sector needs incentives to find cost-efficient solutions for solving sustainable development challenges. As such, private sector involvement will catalyze increases in the stock of infrastructure assets and will strengthen resilience, enabling more sustainable solutions, and improve access to infrastructure services. To this end, incorporating sustainability considerations into procurement processes, through project specifications and award criteria, will help to enhance the impact of private sector infrastructure investments.

1. Challenges and opportunities for least developed countries

Least developed countries are facing a major challenge in raising the resources necessary to providing universal access to basic infrastructure services. With the small size of the domestic private sector and underdeveloped capital markets, they will have to survive with limited domestic public finance and development assistance. New financing vehicles, including through cooperation arrangements and PPPs, could offer potential sources of infrastructure financing, but only after they gain adequate institutional capacities to develop a pipeline of projects in line with the objectives of their development partners.

Nevertheless, a small but gradual progress has been made in larger least developed countries to develop their own domestic capital markets and absorb inflows of private capital. Indeed, domestic capital markets are already large in Bangladesh and Nepal, with stock market capitalization of around 33% (2015) and 45% (2016) of their respective GDP. In Myanmar, a large influx of foreign public and private capital has been seen since 2011 to finance a wide range of projects, including many infrastructure projects. Several airport infrastructure projects have moved ahead with the support of private sector finance. One of these projects, the redevelopment of Mandalay Airport, utilized insurance to mitigate some of the risks for private sector firms financing the project. In Cambodia, a stock exchange was established in 2012, although it is still in the early stages of its development with only four listed companies by 2016. While these recent developments do not instantly provide sufficient sources of financing necessary to close the infrastructure gaps, they can create significant potential in the future for using debt and equity capital for financing infrastructure.

While the outlook for larger least developed countries is positive, at least in relative terms, due to the sustained rapid growth of these economies and the strong foreign investment inflows into all these economies, other smaller least developed countries continue to face many significant challenges. Box 3.6 lays out some of the infrastructure

Box 3.6. Infrastructure financing challenges for Timor-Leste

A fundamental structural problem confronting Timor-Leste is that its oil and gas reserves at its major current offshore fields are rapidly depleting. After achieving independence, economic growth accelerated due to the development of the Bayu Undan field. The revenues from this field helped to boost the Timor-Leste annual economic growth rate between 2007 and 2012 to a double digit pace on average. However, the pace of growth has since moderated as oil and gas revenues have gradually diminished, partly reflecting the slump in world oil and gas prices since 2014, but also due to the gradual depletion of oil and gas fields. The economy could face a rapidly deteriorating fiscal position after 2024 and become highly dependent on donor aid while depleting the assets of its sovereign wealth fund, the Petroleum Fund.

As a result of a protracted conflict, Timor-Leste has faced difficulties in addressing high levels of poverty and malnutrition. Moreover, there have been episodes of renewed civil unrest since independence, which have also delayed economic development. However, efforts by the Government, together with multilateral institutions such as the World Bank and the United Nations, have gradually resulted in some progress.

Timor-Leste has had to build its government institutions, overcome severe shortages of skilled workers as well as tackle issues such as corruption. The quality of physical infrastructure is still very low although the Government has taken efforts to accelerate infrastructure development. All these have resulted in slow progress in achieving economic development goals.

The Government has taken an important step of creating a sovereign wealth fund to set aside some of the country's oil and gas revenues for the future. An estimated $18 billion has been paid into this fund. However, this fund will rapidly be drawn down once oil and gas revenue stops flowing. In the meantime, an urgent challenge facing the Government is to diversify the economy to reduce vulnerability to oil revenue. Key strategic priorities will be to improve physical infrastructure, strengthen human capital and develop new growth industries such as tourism.

Source: Biswas (2017).

financing challenges faced by Timor-Leste. Those with a difficult economic outlook will not be able to develop domestic capital markets due to their small sizes of population and economies. They will have little choice but to make the development of infrastructure dependent on international donor financing in the short term, while making steady efforts towards enhancing domestic revenue mobilization for infrastructure development over the medium to long term.

2. Challenges and opportunities for small island developing States

In the small island developing States, challenges remain in accessing sufficient and appropriate financing. They face high costs of developing new infrastructure facilities due to their geographic isolation. They also encounter a challenge associated with the maintenance of infrastructure, which has been estimated to cost more than what they will need to provide universal access to infrastructure (see the Introduction to this chapter). Insufficient funding towards maintaining completed infrastructure projects has resulted in fast deterioration and costly reconstruction, as exemplified by several major road rehabilitation projects in many small island developing States.

These States are also characterized by a high degree of economic vulnerability due to the relatively small size of their economies, often with narrow economic bases heavily dependent on just a few key industries, such as tourism, agriculture or fisheries. Their vulnerability to climate change and the often devastating effects of natural disasters such as cyclones or tsunamis compound their vulnerability. For example, in Vanuatu and Tuvalu infrastructure damage and losses caused by Cyclone Pam in 2015 were estimated at 8% and 3.7% of GDP, respectively (Vanuatu, 2015). The transport sector accounted for more than half of the damage and losses.

Mobilizing domestic private sector capital for infrastructure financing in such a vulnerable environment is a major hurdle for many small island developing States, particularly as most of them lack substantial pools of domestic private savings in the form of bank deposits, pension funds or insurance funds. In addition, the domestic capital markets are generally very small or non-existent.

Access to external private financing is also limited. International commercial banks have small credit lines for small island developing States due to the small size of their economies. Compared to other developing countries, small island developing States have low shares of external private financing flows from international bank lending and FDI. As a result, many small island developing States are heavily reliant on bilateral and multilateral overseas development assistance. In 2013-2014, development assistance accounted for approximately 20% of government expenditure in Vanuatu and one-third in Cook Islands, while representing about one-half of expenditure in Kiribati, Nauru and Tuvalu (PRIF, 2013; IMF, 2016a).

In view of the limited scope for raising additional resources for infrastructure financing as well as the high cost of improving physical connectivity with large external markets, ICT development has been increasingly seen as a key enabler for sustainable development in small island developing States. ICT infrastructure with good broadband and reliable international connectivity could create opportunities for developing and creating jobs in online and offshore services industries such as customer services, accounting, programming, data processing and other consulting services. It will also have spillover effects for other sectors, such as tourism, health and education, and eventually help small island developing States to overcome barriers of distance and related socio-economic disadvantages.

3. Challenges and opportunities for landlocked developing countries

The landlocked developing countries face special challenges associated with their lack of direct territorial access to the sea, and their remoteness and isolation from world markets. As a result, their infrastructure development and financing become inevitably dependent on their neighbours' infrastructure, political relations with neighbouring countries as well as political stability and the quality and effectiveness of administration in neighbouring and transit countries.

Among landlocked developing countries, the resource-rich economies are better placed to raise domestic resources as resource-based rents can yield significant amounts of finance for infrastructure development. For example, in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan, resource-based rents account for 37%-47% of their GDP. In contrast, non-resource rich landlocked developing countries will continue to need significant external assistance, including ODA, as they have limited capacities to raise domestic and other forms of competitive resources on their own.

Nevertheless, landlocked developing countries are faced with tremendous opportunities in benefitting from multilateral funding agencies. For example, ADB's Central Asia Regional Economic Cooperation (CAREC) programme was launched in 2001 with a special focus on infrastructure development and connectivity in the Central Asian landlocked developing countries. Beginning with

$24.7 million in 2001, CAREC's portfolio of investments had risen to $24.6 billion in 2014. Transport, energy and trade facilitation have been the main focus areas of CAREC activities. Landlocked developing countries are also beneficiaries of many new regional initiatives such as the BRI, as already discussed at the beginning of this chapter.

D. FILLING THE FUNDING GAP: POLICY RECOMMENDATIONS

In order to fill funding gaps, CSN Governments need clear financing strategies and capacity development for effective long-term planning through various modalities, such as improving public expenditure, mobilizing domestic resources, leveraging the private sector, improving access to capital markets and tapping new sources of funds such as climate finance.

In the short term, given their scarce financial resources, many CSN will necessarily have to prioritize which sectors are to be developed. Such prioritization could be based on importance with regard to where the infrastructure gaps are greatest or the impact in terms of cross-sectoral synergy potential or expected sustainable development outcomes. For example, by focusing on providing a stable electricity supply, least developed countries could accelerate the process of expanding productive capacity, which would facilitate a gradual shift from their labour-intensive to capital-intensive activities. An ICT focus of small island developing States, as discussed above, could provide a robust way to optimize their infrastructure portfolio. Because ICT infrastructure could generate certain revenue streams, the private sector can be engaged in the process, while public funds can be used for development of infrastructure with high environmental or social returns, such as WSS, where the private sector does not usually play a major role without government interventions. For landlocked developing countries, priority could be assigned to improving transport infrastructure that connects the missing links with neighbouring countries and remove the bottlenecks to reduce trade costs. This could also boost export earnings that could be used, in turn, to implement energy and WSS infrastructure projects that are necessary to making progress towards broad-based sustainable development.

A clear identification of prioritization, potential partners, financial instruments and necessary government support measures would help Governments improve the efficiency of the infrastructure development process (UNCTAD, 2014). Budget provision should also identify how as well as how much infrastructure should be financed. Such information will not only help Governments clarify their development objectives and strategies but will also help their development partners align their cooperation for infrastructure development with the priorities of CSN.

In the medium to long term, mobilizing domestic public finance is one of the critical elements of providing infrastructure investment. Improved tax policy and administration would expand the fiscal space of Governments with a broadened base and fair tax systems. Significant resources can be also mobilized by raising user charges for some infrastructure services and by possibly adopting the "polluters pay" principle. Road pricing such as toll roads, for example, has proven effective for generating revenues in high-traffic areas as well as helping to reduce emissions and congestion. Similarly, funding for water and sanitation projects can come from cost recovery mechanisms, such as taxes on water pollution, tariffs on wastewater services and pollution discharge permits.

The development of capital markets, although an option only available to countries with sufficiently large domestic markets and economies of scale, has the potential to facilitate a more efficient allocation of the regional savings pool, including in the private sector, to generate long-term financing for investment. A greater variety of financial instruments that would become available through capital markets should help CSN to make infrastructure more attractive to a broader group of investors and should allow for better diversification of risks.

In addition to these financing strategies, CSN Governments will also need to enhance institutional and technical capacity for planning, maintaining and managing infrastructure to ensure that it is utilized in a sustainable and inclusive manner. A robust planning and prioritization process can, in turn, yield substantial financial savings and avoid wasted investment in poorly-designed projects that do not meet development objectives (ESCAP, ADB and UNDP, 2017). The availability and use of new financing options are unlikely to lead to better outcomes in countries with weak governance and institutional capacity.

Practically, the use of an integrated policy approach that combines different types of investments, both in hard and soft infrastructure, has a better chance of enhancing the impact of investments, fostering innovation and generating sustainable productivity gains (OECD, 2015). The allocation of resources to promoting economic and social integration, and nurturing seamless connectivity, will provide the much-needed impetus to investment and trade flows, which are currently being held back because of infrastructure bottlenecks.

ENDNOTES

1 Branchoux, Fang and Tateno (2017) provide full details of the methodologies used to estimate infrastructure financing needs.

2 This finding is in line with Pacific Regional Infrastructure Facility (2013) in which the cost of infrastructure maintenance was found to be high in small island developing States, reaching an average of 6% of GDP for existing infrastructure.

3 Similarly, World Bank and IEA (2015) estimated that developing Asia would need additional investment of $232 billion annually to double their renewable energy consumption by 2030 and $211 billion for energy efficiency improvement in a scenario that is consistent with the two-degree target of the Paris Agreement. These results are also in line with IMF (2016a), where operating expenditure related to climate change contingencies together with new infrastructure maintenance costs, are collectively assumed at around 2% to 3% of GDP in Kiribati.

4 The degree of private sector engagement varies widely across CSN. See the later discussion in this report for details.

5 Other developing countries undertook stimulus spending that peaked around 2009. Since then, public investment in those countries has been declining. The availability of long-term investment financing does not seem to have fully recovered due to persistent weakness and uncertainty in the global economy.

6 Greenfield FDI projects listed on fDi markets are categorized as infrastructure development projects based on the following rules: (a) marked as energy projects if the activity is "electricity"; (b) marked as ICT projects if the activity is "ICT and Internet infrastructure"; and (c) marked as transport projects if the sector is "transportation", the activity is "logistics, distribution and transportation, and the cluster is "transportation, warehousing and storage." There was no WSS project in CSN listed on fDi markets.

7 However, this may also be due to the lack of relevant information available on the World Bank Private Participation in Infrastructure Project Database.

8 For the benefits of PPPs, see ESCAP (2017c).

9 Aid for Trade comprises grants and concessional loans provided to developing countries, in particular the least developed countries, as part of ODA for building capacity and infrastructure for trade-related programmes and projects. Between 2006 and 2013, a total of $129 billion was disbursed to support programmes and projects that are aimed at reducing the infrastructure gap in developing countries. For details, see OECD and WTO (2015).

10 An increasing share of ODA from the Asia-Pacific OECD-DAC members (Australia, Japan, New Zealand and the Republic of Korea) is allocated to least developed countries, particularly those in the Asia-Pacific region.

11 See www.oecd.org/dac/stats/non-dac-reporting.htm (accessed 16 November 2016).

12 For example, the Japan Bank for International Cooperation and the Korea Export-Import Bank are large players in the region.

13 Heavy reliance on foreign assistance in small island developing States is discussed in the next section.

14 See www.aiib.org (accessed 22 December 2016).

15 See www.adb.org/site/aif/projects (accessed 3 January 2017).

16 See www.greenclimate.fund/ (accessed 22 December 2016).

17 See also www.eib.org/investor_relations/cab/index.htm (accessed 29 December 2016).

18 See treasury.worldbank.org/cmd/htm/MoreGreenProjects.html (accessed 29 December 2016).

19 See www.adb.org/site/investors/adb-green-bonds (accessed 29 December 2016).

20 According to the IMF (1993), reserves are external assets that are readily available to, and controlled by monetary authorities for direct financing of external payment imbalances, and to intervene in the exchange markets. The accumulated foreign reserves are normally kept in low-yielding United States treasury bonds or in overseas bank accounts so that they can be used for direct financing of external and internal payments. However, holding a large amount of reserves entails high opportunity costs, and, as foreign reserves continue to build in some CSN, the overall opportunity cost of these low returns will pile up compared to the return on alternative projects.

21 Some of the resource-rich CSN, such as Azerbaijan and Kazakhstan, have been channelling their oil reserves into infrastructure investment.

22 Even among the potentially profitable sectors, some will generate revenue in local currency only, while others will provide currency in United States dollars, making them more attractive to foreign investors.

THE WAY FORWARD

This report argues that investment in infrastructure is critical to the development of the CSN in the region. It presents a framework for integrating infrastructure to achieve sustainable development that highlights the impact of physical infrastructure on the economic, social and environmental pillars of sustainable development, and emphasizes the fact that Governments need to: (a) increase policy coherence across infrastructure sectors; (b) emphasize infrastructure planning in a more holistic manner across various relevant ministries; and (c) undertake complementary policy measures, especially the institutional reforms needed to ensure that the benefits of infrastructure is shared by all.

The report demonstrates that the overall state of physical infrastructure is poor in many CSN, particularly the least developed countries and small island developing States. To capture the multidimensional character of infrastructure, the report introduced the ESCAP Access to Physical Infrastructure Index. This index, which can also be used as tool for development policies in support of sustainable development, demonstrates clearly that significant gaps remain in physical infrastructure relative to other developing and developed countries in the Asia-Pacific region.

To close these gaps by developing infrastructure, and maintaining and rehabilitating existing infrastructure, the CSN in the Asia-Pacific region will need to invest an estimated 10.5% of GDP per annum. This far exceeds their resources. This report therefore identifies financing sources and instruments that are available to CSN for closing their infrastructure deficits.

For infrastructure financing, new sources of long-term finance will need to be tapped through new global and regional initiatives, including climate finance and, in the long term, through development of capital markets to effectively match maturities of domestic savings with long-term infrastructure assets. It should be noted, however, that not all CSN are in a position to benefit from new initiatives or have the potential to develop their own capital markets, as it depends largely upon exogenous factors such as geographic locations and the size of their economies or population. For example, with the small size of the domestic private sector and underdeveloped capital markets, some least developed countries will have to rely on their limited domestic public finances and on greater levels of development assistance. These countries should focus primarily on using public resources for basic infrastructure services that are currently missing, such as stable access to electricity and clean drinking water.

Improved tax administration and broadened tax bases would enable Governments to expand their fiscal space, while significant resources could be mobilized through user charges. Increasing the efficiency of public expenditure would also expand the fiscal space available in those countries. For larger least developed countries, there is scope for expanding domestic public resources, including through enhancing tax revenues, utilizing new regional financing initiatives and, in the medium to long term, developing their own domestic capital markets as this has the potential to facilitate a more efficient allocation of their savings to generate long-term financing for investment.

For smaller least developed countries and small island developing States, where significant resources are critical for maintaining existing infrastructure and upgrading to make it more climate-resilient, donor assistance continues to be a key financing source of infrastructure development.

Since it will be extremely challenging to develop their own capital markets, they will need to find more stable and reliable sources of financing. While climate finance would give them opportunities to narrow the financing needs, Governments need to explicitly recognize climate change adaptation costs and infrastructure maintenance needs in their budget, which will help ensure adequate provision of resources, including from development partners.

In landlocked developing countries, sources of infrastructure financing are more diversified than in least developed countries and small island developing States. Landlocked developing countries are also direct beneficiaries of many new regional initiatives. Nevertheless, the nature of economic structures of landlocked developing countries that are significantly dependent on a narrow range of products for economic activity and export earnings serves to accentuate their vulnerability to external shocks. While the resource-rich countries can continue directing non-tax revenues towards infrastructure development, other landlocked developing countries will have to prioritize in establishing better transport connectivity to neighbouring countries in order to secure sustained economic growth.

In this regard, CSN need to clearly identify priority sectors as well as financial instruments and necessary government support measures to close infrastructure deficits. Doing so will enable development partners to align their cooperation for infrastructure development with the priorities of the CSN.

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ANNEXES

Annex I. Sustainable Development Goals

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystem, sustainably manage forest, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: United Nations.

Annex II. Summary of the indicators

Indicator	Description	Max	Min	SD	Mean	Source
Rail lines total route-km per 1,000 km^2 of land area	Length of railway route available for train service, irrespective of the number of parallel tracks, over land (1,000 km^2).	54.75	0.00	12.45	9.69	World Bank
Roads total network (km) per 1,000 km^2 of land area	Total road network over land (1,000 km^2) where total road network includes motorways, highways and main or national roads, secondary or regional roads and all other roads in a country.	4 916.70	31.70	980.74	670.59	World Bank and the CIA factbook.
Electric power consumption (kWh per capita)	Electric power consumption measures the production of power plants, and combined heat and power plants less transmission, distribution, and transformation losses, and own use by heat and power plants.	10 427.89	128.15	2 921.91	2 538.45	IEA Statistics from OECD/IEA
Access to electricity (percentage of population)	Access to electricity is the percentage of population with access to electricity.	100.00	18.00	24.80	83.55	World Bank
Fixed and mobile telephone subscriptions (per 100 people)	Number of fixed telephone and mobile active lines per 100 people.	205.36	25.47	45.32	122.64	International Telecommunications Union
Internet users (per 100 people)	Internet users are individuals who have used the Internet (from any location) in the past 12 months. Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.	90.22	6.50	25.49	38.48	International Telecommunications Union
Improved sanitation facilities (percentage of population with access)	Access to improved sanitation facilities refers to the percentage of the population using improved sanitation facilities.	100.00	18.90	22.88	75.55	WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation.
Improved water source (percentage of population with access)	Access to an improved water source refers to the percentage of the population using an improved drinking water source.	100.00	39.97	13.87	88.94	WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation.

Notes: The formula used for all the indicators is $\frac{X - Mean\,X}{SDX}$

SD = standard deviation; Max = maximum; Min = minimum

Annex III. Methodology for constructing the APII

The APII is based on a simple statistical methodology to reflect the linkages across the four dimensions and its eight indicators. APII aims to evaluate the average achievements in a country in four dimensions of the physical infrastructure. An index score is computed for each of these indicators of four dimensions with the following methodology:

Step 1: Each of the four indices of the APII is computed to the general formula:

$$Index_{ij} = \left(X_{ij} - MeanX_{ij}\right) / S\tan dardDeviatonX_{ij}$$

where I = indicator/dimension and j = country

Step 2: APII is computed by averaging the values of all four sub-index:

$$APII_{ij} = \frac{1}{4}\left(TR_{ij} + ENR_{ij} + ICT_{ij} + WSS_{ij}\right)$$

Annex IV. Econometric analysis

Three models, based on non-parametric estimation technique (Basu and Das, 2011), are presented in the report based on the database of 104 countries for 1990 to 2015, with three-year average of a total of eight indicators, and subsequent computation of the *Access to Physical Infrastructure Index and four sub-indices for transport, energy, ICT and WSS*.

The nonparametric estimation technique gives an estimate of the value of the regression function (the conditional moment) and its slope at every country-time period combination. To help with the analysis and interpretation of results, slope estimates at the 50th percentiles (labeled quartile 2 or Q2) are provided, and their standard errors obtained via bootstrapping. The table also indicates which estimates are significant at the 90%, 95% or 99% confidence level.

The results reported here are from the 41 Asia-Pacific countries, of which there are 23 CSN and nine least developed countries.

Core model: The objective is to examine the impact of the physical infrastructure (measured by $APII$) and other factors such as general government expenditure ($GCEY$), merchandise trade ($MRYY$) and domestic credit to private sector ($DCPS$) on GDP ($\ln Y$) (table A1). The main model is a semi-log function converted to a non-parametric model represented by three equations below:
Asia-Pacific: Model 1 $\ln Y = (GCEY, MRTY, DCPS, \ln APII)$
Asia-Pacific CSN: Model 2 $\ln Y = m(GCEY, MRTY, DCPS, \ln APII)$
Asia-Pacific least developed countries: Model 3 $\ln Y = m(GCEY, MRTY, DCPS, \ln APII)$
where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%

For each of the tables, all standard errors are in parentheses and are obtained via bootstrapping. *Indicates significance at 10% level; **indicates significance at 5% level; and *** indicates significance at 1% level.

Table A1. Economic impact analysis in selected countries in Asia and the Pacific

	Asia-Pacific	CSN	Least developed countries
Dependent variable: Log of GDP	Model 1	Model 2	Model 3
Access to Physical Infrastructure Index scores	1.33***	1.19***	1.02***
	(.024)	(.038)	(.035)
General government final consumption expenditure (% of GDP)	5.70***	5.79***	5.57***
	(.001)	(.001)	(.002)
Merchandise trade (% of GDP)	0.08***	0.11**	0.21***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.87***	1.00***	0.82***
	(.000)	(.000)	(.000)

Source: ESCAP.

Extended model: The objective is to examine the impact of the physical infrastructure (measured by *APII*) and other factors such as general government expenditure (*GCEY*), merchandise trade (*MRYY*) and domestic credit to private sector (*DCPS*) on the human development index (ln *HDI*) (table A2). The main model is a semi-log function converted to a non-parametric model represented by three equations below:

Asia-Pacific: Model 1 $\ln HDI = (GCEY,MRTY,DCPS,\ln APII)$

Asia-Pacific CSN: Model 2 $\ln HDI = (GCEY,MRTY,DCPS,\ln APII)$

Asia-Pacific least developed countries: Model 3 $\ln HDI = (GCEY,MRTY,DCPS,\ln APII)$

where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%

Table A2. Development impact analysis in selected countries in Asia and the Pacific

	Asia-Pacific	CSN	Least developed countries
Dependent variable: Human development index	Model 1	Model 2	Model 3
Access to Physical Infrastructure Index scores	0.33***	0.32***	0.29***
	(.003)	(.006)	(.009)
General government final consumption expenditure (% of GDP)	0.09***	0.08**	0.02
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	-0.01***	-0.01*	0.04***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.04***	0.05***	0.09***
	(.000)	(.000)	(.000)

Source: ESCAP.

Core model with institutional infrastructure variable: Tables A3 and A4 present medians of nonparametric estimates categorized by property rights or pr (weak to ideal): low pr (0- 39), medium pr (40-69) and high pr (70-100).

Table A3. Economic impact analysis of selected countries in Asia and the Pacific

	All samples	All samples	All samples
Dependent variable: Log of GDP	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	1.22***	1.46***	1.78***
	(.031)	(.029)	(.025)
General government final consumption expenditure (% of GDP)	5.49***	4.37***	3.34***
	(.003)	(.001)	(.001)
Merchandise trade (% of GDP)	0.13***	0.07***	-0.19***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.92***	0.76***	0.66***
	(.000)	(.000)	(.000)

Source: ESCAP.

Extended model with institutional infrastructure variable:

Table A4. Development impact analysis in selected countries in Asia and the Pacific

	All sample	All sample	All sample
Dependent variable: Human development index	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.31***	0.33***	0.33***
	(.003)	(.002)	(.002)
General government final consumption expenditure (% of GDP)	0.13***	0.17***	0.09***
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	-0.01***	-0.02***	-0.03***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.04***	0.00***	0.03***
	(.000)	(.000)	(.000)

Source: ESCAP.

Sectoral Core model: The objective is to examine the impact of the four sectors of the physical infrastructure and other factors such as general government expenditure (*GCEY*), merchandise trade (*MRYY*) and domestic credit to private sector (*DCPS*) on the real GDP ($\ln Y$) for the CSN in Asia and the Pacific (table A5). The main model is a semi-log function converted to a non-parametric model represented by three equations below:

Transport_CSN: Model 1 $\ln Y = m(GCEY,MRTY,DCPS,\ln TR - APII)$

Energy_CSN: Model 2 $\ln Y = m(GCEY,MRTY,DCPS,\ln EN - APII)$

ICT_CSN: Model 3 $\ln Y = m(GCEY,MRTY,DCPS,\ln ICT - APII)$

Water and Sanitation_CSN: Model 4 $\ln Y = m(GCEY,MRTY,DCPS,\ln WSS - APII)$

where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%.

Table A5. Economic impact sectors of infrastructure analysis in selected CSN

	Transport	Energy	ICT	WSS
Dependent variable: Log of GDP	Model 1	Model 2	Model 3	Model 4
Access to Physical Infrastructure Index scores	0.195***	0.83***	0.402***	0.868***
	(.011)	(.028)	(.012)	(.016)
General government final consumption expenditure (% of GDP)	7.8***	5.75***	6.15***	5.48***
	(.002)	(.001)	(.004)	(.006)
Merchandise trade (% of GDP)	0.264***	0.25***	0.121***	0.391***
	(.000)	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	1.73***	1.22***	1.2***	1.73***
	(.000)	(.000)	(.000)	(.000)

Source: ESCAP.

Core model with institutional infrastructure variable: Tables A6 to A9 present medians of non-parametric estimates categorized by property rights or pr (weak to ideal) low pr (0-39), medium pr (40-69) and high pr (70-100)

where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%.

Table A6. Transport sector: Economic impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Log of GDP	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.223***	0.26***	0.322***
	(.007)	(.014)	(.008)
General government final consumption expenditure (% of GDP)	8.13***	7.89***	8.0***
	(.003)	(.002)	(.003)
Merchandise trade (% of GDP)	0.052	0.081	-0.55***
	(.000)	(.001)	(.000)
Domestic credit to private sector (% of GDP)	1.69***	1.56***	1.53***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A7. Energy sector: Economic impact analysis in selected CSN

	All sample	All sample	All sample
Dependent variable: Log of GDP	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.88***	0.98***	1.18***
	(.015)	(.027)	(.016)
General government final consumption expenditure (% of GDP)	5.78***	4.43***	3.27***
	(.001)	(.002)	(.002)
Merchandise trade (% of GDP)	0.25***	0.20***	0.02
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	1.04***	0.96***	0.88***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A8. ICT sector: Economic impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Log of GDP	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.399***	0.509***	0.622***
	(0.01)	(.014)	(.009)
General government final consumption expenditure (% of GDP)	6.19***	5.29***	4.73***
	(.002)	(.002)	(.002)
Merchandise trade (% of GDP)	0.177***	0.056*	-0.073***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	1.21***	1.04***	0.947***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A9. WSS sector: Economic impact analysis in selected CSN

	All sample	All sample	All sample
Dependent variable: Log of GDP	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.828***	0.97***	1.09***
	(.015)	(.038)	(.016)
General government final consumption expenditure (% of GDP)	6.36***	6.17***	6.05***
	(.005)	(.002)	(.002)
Merchandise trade (% of GDP)	0.343***	0.337***	0.086***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	1.55***	1.41***	1.45***
	(.000)	(.000)	(.000)

Source: ESCAP.

Extended model: The objective is to examine the impact of the four sectors of the physical infrastructure and other factors such as general government expenditure (*GCEY*), merchandise trade (*MRYY*) and domestic credit to private sector (*DCPS*) on human development index (ln *HDI)* for the CSN in Asia and the Pacific (table A10). The main model is a semi-log function converted to a non-parametric model represented by three equations below:

Transport_CSN: Model 1 $\ln HDI = m(GCEY,MRTY,DCPS,\ln TR - APII)$

Energy_CSN: Model 2 $\ln HDI = m(GCEY,MRTY,DCPS,\ln EN - APII)$

ICT_CSN: Model 3 $\ln HDI = m(GCEY,MRTY,DCPS,\ln ICT - APII)$

Water and sanitation_CSN: Model 4 $\ln HDI = m(GCEY,MRTY,DCPS,\ln WSS - APII)$

where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%

Table A10. Development impact on sectors of infrastructure analysis in selected CSN

	Transport	Energy	ICT	WSS
Dependent variable: Human development index	Model 1	Model 2	Model 3	Model 4
Access to Physical Infrastructure Index scores	0.064***	0.21***	0.162***	0.316***
	(.002)	(.004)	(.005)	(.008)
General government final consumption expenditure (% of GDP)	0.897***	0.34***	-0.245***	0.456***
	(.000)	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	0.008	0.00	-0.000	0.028***
	(.000)	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.242***	0.14***	0.076***	0.145***
	(.000)	(.000)	(.000)	(.000)

Source: ESCAP.

Core model with institutional infrastructure variable: Tables A11 to A14 present medians of non-parametric estimates categorized by property rights or pr (weak to ideal) – low pr (0-39), medium pr (40-69) and high pr (70-100)

where b = coefficient of X in table of result below, and if X (independent) increases by 1%, Y (dependent) changes by b%

Table A11. Transport sector development impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Human development index	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.055***	0.068***	0.067***
	(.002)	(.001)	(.001)
General government final consumption expenditure (% of GDP)	0.852***	1.0***	1.04***
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	0.011**	0.004	0.016***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.211***	0.197***	0.161***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A12. Energy sector development impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Human development index	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.21***	0.22***	0.22***
	(.003)	(.001)	(.003)
General government final consumption expenditure (% of GDP)	0.21***	0.31***	0.29***
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	0.00	0.00*	0.00***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.00***	0.04***	0.04***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A13. ICT sector development impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Human development index	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.174***	0.161***	0.155***
	(.003)	(.005)	(.008)
General government final consumption expenditure (% of GDP)	-0.083	-0.006	0.189***
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	-0.000	-0.006**	-0.009***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.064***	0.037***	0.031***
	(.000)	(.000)	(.000)

Source: ESCAP.

Table A14. WSS sector development impact analysis in selected CSN

	All samples	All samples	All samples
Dependent variable: Human development index	Low institutional quality	Medium institutional quality	High institutional quality
Access to Physical Infrastructure Index scores	0.313***	0.363***	0.397***
	(.005)	(.005)	(.004)
General government final consumption expenditure (% of GDP)	0.427***	0.47***	0.538***
	(.000)	(.000)	(.000)
Merchandise trade (% of GDP)	0.022***	0.017***	0.011***
	(.000)	(.000)	(.000)
Domestic credit to private sector (% of GDP)	0.122***	0.104***	0.118***
	(.000)	(.000)	(.000)

Source: ESCAP.

Annex V. GTAP simulation analysis

The GTAP model is a comparative static model, based on neoclassical theories. The GTAP model is a linearized model, and it uses a common global database for CGE analysis. The model assumes perfect competition in all markets, constant returns to scale in all production and trade activities, and profit maximizing behaviour by firms and utility maximizing behaviour by households. The model is solved using the GEMPACK software (Harrison and Pearson, 1996).

Version 9 of the GTAP database covers 57 commodities, 140 regions/countries, and 5 factors of production. The current study merged the 57 commodities into 4 and also merged 140 regions into 14, as shown in tables A1 and A2, respectively.

Table A1. GTAP commodity aggregation

No	Description	Sectors
1	Agriculture	Paddy rice; wheat; cereal grains nec; vegetables, fruit, nuts; oil seeds; sugar cane, sugar beet; plant-based fibres; crops nec; cattle, sheep, goats, horses; animal products nec; raw milk; wool, silk-worm cocoons; forestry; fishing; meat: cattle, sheep, goats, horses; meat products nec; processed rice.
2	Industry	Coal; oil; gas; minerals nec; vegetable oils and fats; dairy products; sugar; food products nec; beverages and tobacco products; textiles; wearing apparel; leather products; wood products; paper products, publishing; petroleum, coal products; chemical, rubber, plastic prods; mineral products nec; ferrous metals; metals nec; metal products; motor vehicles and parts; transport equipment nec; electronic equipment; machinery and equipment nec; manufactures nec.
3	Infrastructure	Electricity; gas manufacture, distribution; water; construction; communication.
4	Services	Trade; transport nec; sea transport; air transport; financial services nec; insurance; business services nec; recreation and other services; public administration/defence/health/education; dwellings.

Source: GTAP Database 9.

Note: nec means not elsewhere classified. Full documentation of the GTAP model and the database can be found in Hertel, 1997 and Dimaranan and McDougall, 2002.

Table A2. GTAP region aggregation

No	Description	Regions
1	Oceania	Pacific islands.
2	Mongolia	Mongolia.
3	Cambodia	Cambodia.
4	Lao PDR	Lao People's Democratic Republic.
5	MyanTimor	Myanmar and Timor-Leste.
6	Bangladesh	Bangladesh.
7	Nepal	Nepal.
8	AfBhuMal	Afghanistan, Bhutan, Maldives.
9	Azerbaijan	Azerbaijan.
10	Kazakhstan	Kazakhstan.
11	Kyrgyzstan	Kyrgyzstan.
12	TajTurUz	Tajikistan, Turkmenistan, Uzbekistan.
13	Armenia	Armenia.
14	Rest of the world	Australia; New Zealand; China; Hong Kong, China; Japan; Republic of Korea; Taiwan Province of China; rest of East Asia; Brunei Darussalam; Indonesia; Malaysia; the Philippines; Singapore; Thailand; Viet Nam; India; Pakistan; Sri Lanka; Canada; United States of America; Mexico; rest of North America; Argentina; Bolivia; Brazil; Chile; Colombia; Ecuador; Paraguay; Peru; Uruguay; Venezuela; Rest of South America; Costa Rica; Guatemala; Honduras; Nicaragua; Panama; El Salvador; rest of Central America; Dominican Republic; Jamaica; Puerto Rico; Trinidad and Tobago; Caribbean; Austria; Belgium; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Netherlands; Poland; Portugal; Slovakia; Slovenia; Spain; Sweden; United Kingdom; Switzerland; Norway; rest of EFTA; Albania; Bulgaria; Belarus; Croatia; Romania; Russian Federation; Ukraine; rest of Eastern Europe; rest of Europe; Georgia; Bahrain; Islamic Republic of Iran; Israel; Jordan; Kuwait; Oman; Qatar; Saudi Arabia; Turkey; United Arab Emirates; rest of West Asia; Egypt; Morocco; Tunisia; rest of North Africa; Benin; Burkina Faso; Cameroon; Cote d'Ivoire; Ghana; Guinea; Nigeria; Senegal; Togo; rest of West Africa; Central Africa; South-Central Africa; Ethiopia; Kenya; Madagascar; Malawi; Mauritius; Mozambique; Rwanda; Tanzania; Uganda; Zambia; Zimbabwe; rest of East Africa; Botswana; Namibia; South Africa; rest of South African Customs; rest of the World.

Source: GTAP Database 9.

The scenarios of infrastructural development are run by shocking on 'aoall' parameter of the infrastructure sector in the GTAP model. The parameter 'aoall', is the output augmenting technical change in sector *j* of country *r*. The percentage changes in the infrastructural indices from the base values in 2015 are used to construct the shocks in the GTAP model.

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The *Asia-Pacific Countries with Special Needs Development Report 2017* highlights the importance of physical infrastructure to the development of the Asia-Pacific least developed countries, landlocked developing countries and small island developing States, collectively referred to as countries with special needs.

For that purpose, it introduces the ESCAP Access to Physical Infrastructure Index to capture the multidimensional character of infrastructure. This index, which is computed for 41 countries in the Asia-Pacific region, of which 23 are countries with special needs, demonstrates that the overall state of physical infrastructure is poor, particularly in the least developed countries and small island developing States. Indeed, significant gaps remain in physical infrastructure in countries with special needs relative to other developing and developed countries in the Asia-Pacific region.

The report also estimates the investment requirements to close existing infrastructure gaps. As these far exceed existing resources in the countries with special needs, the report identifies potential financing sources and instruments that are available. In doing so, the report highlights priority sectors and financial instruments that the different country groups of the countries with special needs should utilize in order to close infrastructure deficits.

ISBN 978-92-1-120743-9

17-00406