



REIMAGINING THE FUTURE OF TRANSPORT ACROSS ASIA AND THE PACIFIC

JANUARY 2022

ARUP



i

REIMAGINING THE FUTURE OF TRANSPORT ACROSS ASIA AND THE PACIFIC

JANUARY 2022

ARUP





Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO)

© 2022 Asian Development Bank
6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 8632 4444; Fax +63 2 8636 2444
www.adb.org

Some rights reserved. Published in 2022.

ISBN: 978-92-9269-093-9 (print), 978-92-9269-094-6 (electronic), 978-92-9269-095-3 (ebook)
Publication Stock No. SPR210401-2
DOI: <http://dx.doi.org/10.22617/SPR210401-2>

The views expressed in this publication are those of the authors and do not necessarily reflect the views and policies of the Asian Development Bank (ADB) or its Board of Governors or the governments they represent.

ADB does not guarantee the accuracy of the data included in this publication and accepts no responsibility for any consequence of their use. The mention of specific companies or products of manufacturers does not imply that they are endorsed or recommended by ADB in preference to others of a similar nature that are not mentioned.

By making any designation of or reference to a particular territory or geographic area, or by using the term "country" in this document, ADB does not intend to make any judgments as to the legal or other status of any territory or area.

This work is available under the Creative Commons Attribution 3.0 IGO license (CC BY 3.0 IGO) <https://creativecommons.org/licenses/by/3.0/igo/>. By using the content of this publication, you agree to be bound by the terms of this license. For attribution, translations, adaptations, and permissions, please read the provisions and terms of use at <https://www.adb.org/terms-use#openaccess>.

This CC license does not apply to non-ADB copyright materials in this publication. If the material is attributed to another source, please contact the copyright owner or publisher of that source for permission to reproduce it. ADB cannot be held liable for any claims that arise as a result of your use of the material.

Please contact pubsmarketing@adb.org if you have questions or comments with respect to content, or if you wish to obtain copyright permission for your intended use that does not fall within these terms, or for permission to use the ADB logo.

Corrigenda to ADB publications may be found at <http://www.adb.org/publications/corrigenda>.

Notes:

In this publication, "\$" refers to United States dollars.

ADB recognizes "Hong Kong" as Hong Kong, China and "Hanoi" as Ha Noi.

Cover design by Eleanor Tomlinson.

Contents

Tables and Figures	iv
Foreword	v
Acknowledgments	vi
Abbreviations	viii
Reimagining the Future of Transport	1
An Alternative Approach to Planning and Investments	4
Ten Trends Shaping the Future of Transport	6
Playbook	8
How to Use This Document	9
Plausible Visions for Future Transport in Asia and the Pacific	10
Vision 1: Safe, Reliable, and Efficient Systems	14
Vision 2: Inclusive and Accessible Spaces and Services	22
Vision 3: Deliver Resilient Transport Infrastructure Systems	30
Vision 4: Seamless Transport and Logistics Systems	38
Vision 5: Deliver Environmentally Considerate Outcomes	46
Vision 6: Robust Institutional, Financial, and Technical Capacity	54
Vision 7: Technology-Enabled Transport Services	62
Vision 8: Strong Regional Cooperation and Comprehensive Development	70
Conclusion	78
Appendix	80

Tables and Figures

TABLES

1	Vision 1 Matrix	18
2	Vision 1 Underlying Trends	21
3	Vision 1 ADB Strategy 2030 Operational Priorities	21
4	Vision 1 Quality Infrastructure Principles	21
5	Vision 2 Matrix	26
6	Vision 2 Underlying Trends	29
7	Vision 2 ADB Strategy 2030 Operational Priorities	29
8	Vision 2 Quality Infrastructure Principles	29
9	Vision 3 Matrix	34
10	Vision 3 Underlying Trends	37
11	Vision 3 ADB Strategy 2030 Operational Priorities	37
12	Vision 3 Quality Infrastructure Principles	37
13	Vision 4 Matrix	42
14	Vision 4 Underlying Trends	45
15	Vision 4 ADB Strategy 2030 Operational Priorities	45
16	Vision 4 Quality Infrastructure Principles	45
17	Vision 5 Matrix	50
18	Vision 5 Underlying Trends	53
19	Vision 5 ADB Strategy 2030 Operational Priorities	53
20	Vision 5 Quality Infrastructure Principles	53
21	Vision 6 Matrix	58
22	Vision 6 Underlying Trends	61
23	Vision 6 ADB Strategy 2030 Operational Priorities	61
24	Vision 6 Quality Infrastructure Principles	61
25	Vision 7 Matrix	66
26	Vision 7 Underlying Trends	69
27	Vision 7 ADB Strategy 2030 Operational Priorities	69
28	Vision 7 Quality Infrastructure Principles	69
29	Vision 8 Matrix	74
30	Vision 8 Underlying Trends	77
31	Vision 8 ADB Strategy 2030 Operational Priorities	77
32	Vision 8 Quality Infrastructure Principles	77

FIGURES

1	Arup and ADB's Approach to Foresight Analysis	5
2	Vision Framework	11
3	Vision Table Template	11

Foreword

Transport is crucial to social and economic development across Asia and the Pacific. It creates opportunities for growth, generates jobs, and facilitates trade. However, the design and delivery of transport services is expected to become increasingly complex in the coming decades.

The social and technological changes of recent years have greatly altered the way transport systems are used, and some may no longer meet needs. Changes in the coming decades will be even more significant. Rapid population growth, aging populations, climate change, and urban migration will strain transport systems and significantly alter mobility in the region. The ongoing coronavirus disease (COVID-19) pandemic and its impact on transport brings these challenges into sharp focus; it has revealed financing challenges, particularly the viability of mass-transit systems. The status quo in transport planning and management may lead to greater developmental challenges and costs for future generations.

“Future thinking” can help prepare our societies for tomorrow’s challenges. The Asian Development Bank (ADB) has therefore begun applying “foresight techniques” to help planning in the region.¹ This publication, which focuses on the future of transport in Asia and the Pacific, is the first deep dive into a specific sector—transport—and the complex systems that are connected to it.

Mainly, the study seeks insights that can help decision-makers in ADB’s developing member countries and their partners to build a shared view of a desired future for transport and mobility.

Leveraging foresight, they can identify emerging opportunities and inspire collaboration and action toward a transport system appropriate for tomorrow’s needs.

This study was, in part, triggered by recommendations in ADB’s Independent Evaluation Department Sector-Wide Evaluation Report, which recommended the need to develop a transport sector directional guidance paper to operationalize the sustainable transport agenda. This calls for ADB to consider how the design of future transport strategies and interventions can be embedded into country operations, taking into consideration Strategy 2030, which focuses on eradicating extreme poverty and strives to achieve a prosperous, inclusive, resilient, and sustainable Asia and the Pacific.²

This unique study partnership between ADB and Arup Foresight leverages the collective experience and contextual knowledge of ADB’s development practitioners with Arup’s rich experience in foresight. Whether it is inspiring strategy development at the national level, sector-focused scenario planning, or stand-alone scrutiny of individual projects, it is hoped this publication will catalyze conversations about transport systems across Asia and the Pacific.

BRUNO CARRASCO

Director General concurrently Chief Compliance Officer, Sustainable Development and Climate Change Department
Asian Development Bank

¹ADB. 2020. *Futures Thinking in Asia and the Pacific: Why Foresight Matters for Policy Makers*. Manila.

²ADB. 2020. *Sector-Wide Evaluation, ADB Support for Transport 2010–2018*. Manila.

Acknowledgments

The Asian Development Bank (ADB) and Arup acknowledge the valuable inputs and contributions of stakeholders that contributed to the publication. ADB Management strongly supported the study, beginning with Woochong Um, managing director general (former director general of the Sustainable Development and Climate Change Department [SDCC]). Bruno Carrasco, director general concurrently chief compliance officer, Robert Guild, chief sector officer, and James Leather, chief of Transport Sector Group, provided overall guidance; and Susann Roth, chief of Knowledge Advisory Services Center, provided central support in initiating and exploring Futures and Foresight approach in the transport sector.

The team also appreciates instrumental support from ADB's transport divisions, and thanks go to Dong-Soo Pyo (former director, Central and West Asia Department [CWRD]), Hideaki Iwasaki (director, CWRD), Yong Ye (country director, Pakistan Resident Mission; former director, CWRD), Sujata Gupta (director, East Asia Department), Dong Kyu Lee (director, Pacific Department), Ravi Peri (director, South Asia Department), and Hiroaki Yamaguchi (director, Southeast Asia Department).

SDCC staff, ADB's operations departments, and resident missions, have also contributed greatly in various consultations. In particular, we wish to thank the following ADB staff, who are members of the Transport Foresight working group: Andri Heriawan, Arghya Sinha Roy, Ari J. Kalliokoski, Aruna Uddeepta Nanayakkara, Ashish Narain, Belinda Hewitt, Bertrand Goalou, Chenglong Chu, David C. Elzinga, David Fay, Faraj Huseynbeyov, Gengwen

Zhao, Hanif A. Rahemtulla, Hong Soo Lee, Jeffrey M. Miller, Karma Yangzom, Ki-Joon Kim, Kuancheng Huang, Lloyd Wright, Malte Maass, Md. Abul Basher, Michael Anyala, Mukund Sinha, Naresh Pradhan, Nicolas E. Dei Castelli, Noelle O'Brien, Oliver Chapman, Prabhjot Rehan Khan, Robert Valkovic, Rustam Ishenaliev, Sarosh Khan, Seok Yong Yoon, Susan Lim, Takeshi Fukayama, Tashi Lhamo, Valerie Lisack, and Yidan Luo.

We also acknowledge the external experts from our partner organizations who participated in the virtual Foresight workshop in 2020: Benjamin de la Pena, Chenglong Chu, Cornie Huizenga, Fred Young, Gan Chin Wei, Gayang Ho, Gohar Mousaelyan, Kai Xu, Maysho Prashad, Melanie Ulrich, Minh Nguyen, Nikhil Bugalia, Norris Dodd, Sonal Shah, Sudhir Gota, Tanvi Maheshwari, and Xulong Li.

From ADB, the study was led by Alexandra Pamela Chiang, (senior transport specialist), Arndt Husar (senior public management specialist—Digital Transformation), Rebecca Stapleton (transport specialist), and Diana Marie Hernandez-Louis (transport officer). The production of the publication was managed by Franzella Pinky Villanueva (associate operations analyst), Noel Chavez (operations assistant), and Andres Kawagi Fernan (communications consultant).

From Arup, the study was led by Josef Hargrave (global foresight leader). Arup's foresight team contributed valuable technical advice and research, including Jonelle Simunich, Foresight project manager; Anne Kovachevich, Regional foresight leader; Michael Chadney, regional transport advisor;

George Quezada, foresight advisor; Laetitia Lucy, urban economics advisor; Eva Smaga, transport economics advisor; Kieran Birtill, international development; Rhiannon Williams, case study expert; Eleanor Tomlinson, graphics; Bill Searle, graphics, and Len Williams, editor.

A broad range of expert views were consulted within Arup. We thank William Baumgardner (United States [US]), Malcolm Smith (Australia), Neil Walmsley (Singapore), Richard de Cani (United Kingdom [UK]), Alexander Jan (UK), Zita Langenbach (Ireland), Tim Gammons (UK), Trent Lethco (US), Olga Skotareva (UK), Stephan Bennett (UK), Corey Wong (Hong Kong, China), Shan-Shan Wang (Hong Kong, China), Mandana Kazem (UK), Nick Bec (UK), Lucy Pike (Australia), Bruce Johnson (Australia), Mei-Yee Man Oram (UK), Samantha Stratton-Short (Philippines), Rory Canavan (UK), Richard Boyd (UK), Ian Lumsden (UK), Graham Naylor-Smith (UK), Iris Gramegna (UK), James Macken (Australia), Ritu Garg (UK), Vic Currens (UK), Len Williams (UK), and Lola Bushnell (UK).

Abbreviations

ADB	Asian Development Bank
AI	artificial intelligence
COVID-19	coronavirus disease
CWRD	Central and West Asia Department
GHG	greenhouse gas
OP	operational priorities
UK	United Kingdom
UNSDGs	United Nations Sustainable Development Goals
US	United States

Reimagining the Future of Transport

A RAPIDLY CHANGING REGION

Asia and the Pacific is undergoing profound demographic, technological, economic, and environmental change. From major industrial economies such as the People’s Republic of China to Pacific nations such as Kiribati, these trends are intersecting with local circumstances in a highly diverse region. This study attempts to make sense of these regional trends and estimates how they will affect mobility needs.

The megatrends shaping transport in the region are reasonably easy to identify. However, their impact and relative priority will vary depending on place and context. For many countries, climate change will be the predominant trend to consider. For example, how will rising sea levels affect road networks in Bangladesh or lifeline maritime and aviation infrastructure in the Pacific? In others, greater focus is likely to be on the use of novel technological advancements. How can Nepal’s cities transition to the use of electric vehicles? And in some it is a question of demographics. How should cities with aging populations adapt mass transit systems so they are friendly to many more senior citizens?

Deciding which policy and investment decision is appropriate in response to a trend depends on factors such as geography, existing infrastructure, institutional capacity, and the overall investment pipeline.

A HOLISTIC LOOK AT THE FUTURE

This study offers a holistic overview of the trends shaping transport across Asia and the Pacific. The study identifies 10 key trends that will affect transport and their associated opportunities, risks, and uncertainties. In doing so, it demonstrates the importance of systems-thinking and multi-sector approaches to uncover needs and opportunities. A critical component of this work has been a program of stakeholder engagement, ensuring that trends were considered and analyzed from local and regional contexts and expectations.

Drawing on this analysis, a set of visions has been developed to stimulate discussion and inspire new pathways and approaches for investment, planning, and transport policy. These visions incorporate the Strategy 2030 Operational Priorities and the Quality Infrastructure Principles of the Asian Development Bank (ADB) (see Appendix, p. 88).

Through the accompanying “Playbook”—which leverages study outputs (visions and trend cards), ADB developing member countries, ADB’s country programming and project teams, and other transport practitioners—the study delves deeper into respective contexts and focus areas. The Playbook provides practical guidance and tools to facilitate application of foresight tools in a workshop or meeting setting. The Playbook can be used to create long-term visions, build strategies and policies, and future-proof existing or new transport projects.



Girl on a train in India
(photo by JK on Unsplash).

An Alternative Approach to Planning and Investments

Transport projects and investments typically have long project life cycles. Planning, design, and construction can take years from the initial concept to start of operations. When projects are measured in decades, we need to ensure that decisions during the concept and design phase consider changes that can and will happen in the years ahead. We need to design for tomorrow's reality, not today's. The same is true for policy choices, where we must try to understand future social, technological, economic, environmental, and political contexts in the decisions now.

Prior to the COVID-19 pandemic, trends such as urbanization, aging populations, new working patterns, climate change, shared economy, and digital transformation were already reshaping transport. Furthermore, international frameworks such as the United Nations Sustainable Development Goals (UN SDGs) have set targets and guidelines for a more sustainable and resilient future. COVID-19 has accelerated some of these trends.

Some trends are common across the Asia and the Pacific region. These include aging infrastructure, slow integration of transport modes and networks, challenges in asset maintenance, and a lack of institutional capacity. Other trends are more specific to subregions, such as countries experiencing conflicts in Central and West Asia or existential threats from sea levels rising in small island developing states, especially in the Pacific.

Transport—here defined as the movement of people and goods over land, water, and air—underpins and interacts with many other sectors in society. As such, it is shaped by a wide range of interrelated and sometimes conflicting factors: from environmental degradation to population density to changes in user behavior and technology integration. When we talk about the future of transport, we must consider themes such as land use, supply chains, work patterns, leisure preferences, societal well-being, energy, and resources. Global interconnectedness and cross-regional influences impact the diversity of trends and drivers even further, making the future of transport a particularly complex topic to explore.

This study addresses some of this complexity through an overview of the key trends, as noted. It develops draft visions for a future that can spark dialogue and lead to more sustainable, resilient, and inclusive outcomes. Additionally, this could maximize investment returns from new transport infrastructure, not just financially and economically, but also socially and environmentally.

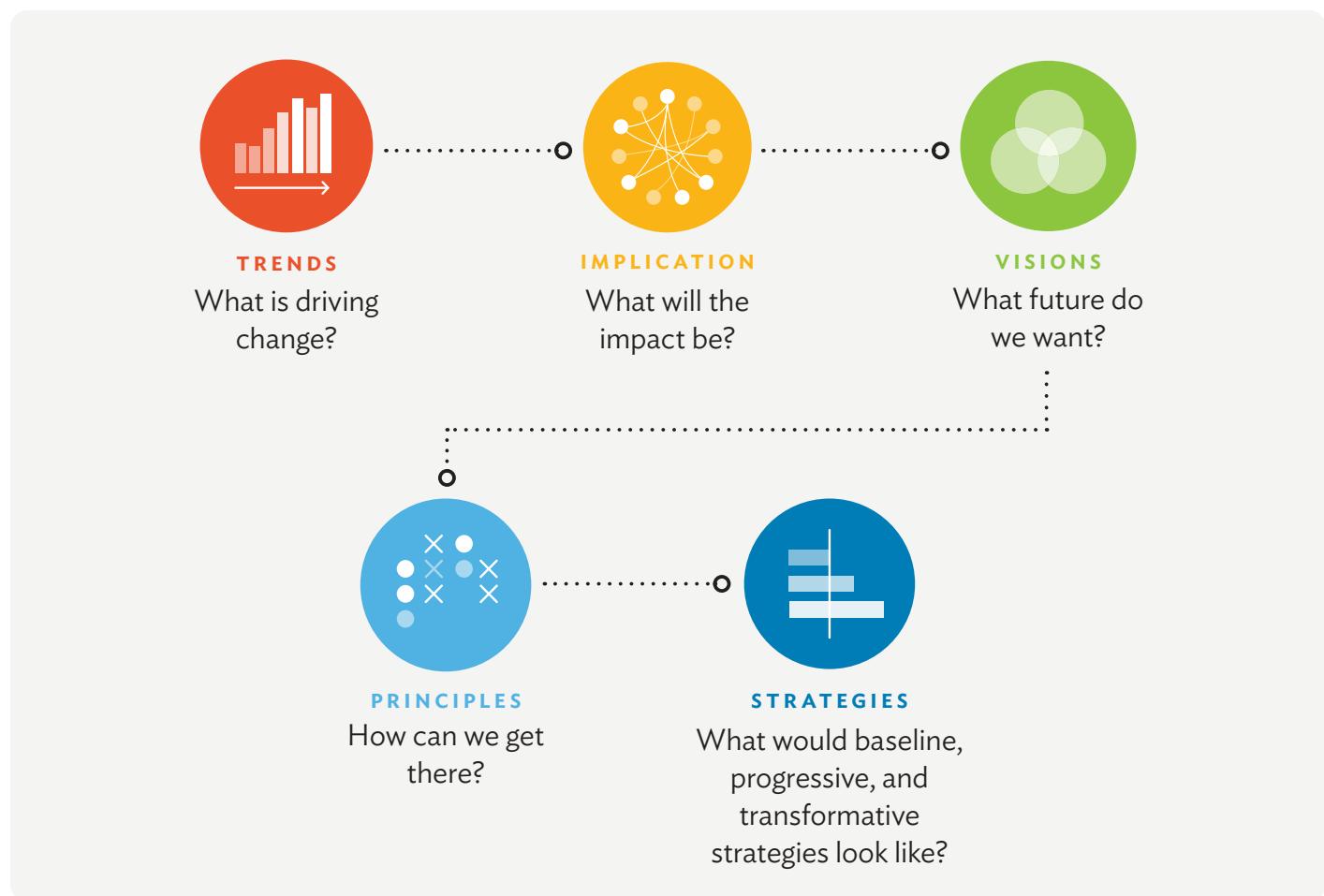
The study involved in-depth research and extensive consultations to identify and analyze those key trends across Asia and the Pacific. In particular, it sought collective contributions from experts at ADB and Arup, and conducted a focus group consultation with industry experts in 2020. The 10 trends drawn up, by no means an exhaustive list, identify projections, opportunities, risks, critical uncertainties, and COVID-19 considerations likely to affect transport in the region.

WHAT IS FORESIGHT?

Foresight is not about predicting the future. Instead, it is about a deeper understanding of what is plausible and possible in the years ahead. It is achieved through the comprehensive analysis of trends, and then assesses how they may realistically "play out" in specific contexts.

To support the process, eight broad visions were drafted, covering a wide range of "desirable futures." Under each vision, incremental principles and strategies were defined for different levels of readiness across those countries. This is to help ADB and its developing member countries to "play out" and consider how future transport systems should look and operate.

FIGURE 1: ARUP AND ADB'S APPROACH TO FORESIGHT ANALYSIS



Source: Authors.

Ten Trends Shaping the Future of Transport

Ten trend cards, and 30 key aspects, have been developed to accompany this report. These cards inform the possible and plausible visions for transport in Asia and the Pacific. A trend is defined as an emerging pattern of change likely to impact a specific focus area. Trends were selected for their expected influence on transport in the region.

While some of these trends may be more important for particular subregions, others are global, but carry regional or local implications. The trends provide a holistic and concise overview of key changes to consider when making decisions for transport in a respective city, country, or region. They help understand the speed and location of change, and how one thematic area relates to another. These are the 10 trends:

POPULATION PATTERNS

Urbanization in Asia and the Pacific has been among the fastest in the world over the past 40 years. At the same time, population is growing and demographics changing. Inclusive transportation systems will be crucial to cater to all transport user groups and to provide safe, secure, and affordable transportation for communities across gender, age, mobility, and other characteristics.

BEHAVIOR PATTERNS

Disposable incomes are projected to continue to grow significantly in Asia and the Pacific and impact consumption and travel patterns. Across all countries, the rapidly advancing digital economy and growth in e-commerce will offer access to new markets, coupled with growing consumer demand for convenience and efficiency. The region's share of travel and tourism is also set to increase

in coming decades. Healthy and sustainable lifestyles are increasingly appealing to consumers, particularly in upper and middle-income countries in Asia.

INTEGRATED TRANSPORT SYSTEMS

Greater availability to operators and users of real-time system data and information is driving integration across transport networks and modes. Transport modes and operators are diversifying rapidly in Asia and the Pacific, and demand for accessibility and efficiency is growing across transport systems.

ADAPTIVE INFRASTRUCTURE PLANNING

Growing populations and demand for movement of goods require adequate infrastructure to achieve sustainable growth. This infrastructure can be provided through adaptation and repurposing or by new investments. Asia and the Pacific will need to tackle its aging infrastructure and harness advanced technology to repair and maintain transport assets to get the most out of existing systems.

CLIMATE CHANGE

Transport sector greenhouse gas emissions are projected to increase significantly in Asia's developing countries in the coming decades. Climate and disaster impacts on transport systems are also increasing, leading to severe damage, disruption, and widespread economic losses. Climate change is accelerating this trend. Driven by international agreements and rapidly evolving climate policy, developing countries are increasingly impelled to enhance resilience and reduce transport system greenhouse gas emissions.

ENVIRONMENTAL RISK

Economies and cities in the region continue to develop at the expense of the environment. Environmental hazards such as flooding and soil erosion are detrimental to transport systems. These environmental risks, which are often caused by poorly designed transport infrastructure, can destroy infrastructure or networks. Transport is a major source of pollution (air, water, land, and noise) and a key factor driving biodiversity loss. Management of ecosystem services and applying nature-based solutions in transport planning and design can benefit biodiversity and enhance the sustainability of transport infrastructure at the same time.

ADVANCED TECHNOLOGIES

Advanced digital technologies including data capture and analysis, autonomous systems, artificial intelligence (AI), machine learning, and internet of things are transforming how transport systems are managed, used, and reimagined. If technologies are deployed with a user- and outcome-led focus, they can significantly alter the experience and operation of journeys, across all modes. A focus of technology advancement will be better integration of different modes, as well as integration of transport with other aspects of society.

ENERGY AND RESOURCES

Environmental challenges and climate change are driving the need for transport energy system transformation, including better integration of low-carbon energy sources and energy efficiency. Hydrogen and system electrification are high on the agenda. At the same time, transport systems need to evolve to meet increasing demand for mobility and changes in human behavior and trade patterns. Resource extraction and consumption

and generation of waste, including from transport, is highest in Asia and the Pacific.⁴ This situation presents opportunities for transport to promote “circularity” and reduce waste generation.⁵

ECONOMIC AND TRADE PATTERNS

Asia and the Pacific’s strong trade and financial integration is integral to the region’s success, with opportunities in further integration of rural economies and markets. At the same time, several future growth sectors and economies require development and investments to maximize opportunity in coming decades, including the sharing, circular, and green economies. Transport investments can play a critical role, not just in connecting markets, but also to facilitate new growth opportunities within specific sectors.

GEO POLITICS AND POLICIES

Countries are more globally and regionally connected than ever. Yet, cross-regional and intra-regional potential for conflict is increasing. New frameworks, agreements, and wider political international relationships are shaping the growth of transport across Asia and the Pacific, while local political situations heavily influence the implementation and success of transport projects through transport policy.

These 10 trends serve as foundational considerations that enable project developers to define the long-term outlook for their specific focus areas. These could range from national strategies to sector strategies and policies and to individual projects.

CLICK TO DOWNLOAD

Trend cards



⁴ UN Environment Programme (UNEP). 2017. *Assessing Global Resource Use: A Systems Approach to Resource Efficiency and Pollution*. Nairobi: UNEP. https://www.resourcepanel.org/sites/default/files/documents/document/media/assessing_global_resource_use_amended_130318.pdf

⁵ Circularity in transport refers to a system aimed at eliminating the continual use of resources and optimizes re-use of resources (e.g., promoting ride sharing rather than commuting alone in a car).

Playbook

An accompanying Playbook (published separately) has been developed to enable project teams to apply foresight in their specific focus areas. The Playbook offers structured pathways and easy-to-use templates, and gives access to key files, reference material, and tools to support workshop delivery. It also supports use of future trends and visions in collaboration with respective stakeholders and clients. You can use and adapt it to develop your own journey in a way that matches your institutional context and challenges:

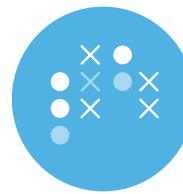
CLICK TO DOWNLOAD

Playbook



MAP TRENDS

Create a futures-informed situation analysis, identifying the impact of emerging trends on a project, theme, sector, or context (subnational, national, subregional, regional, global).



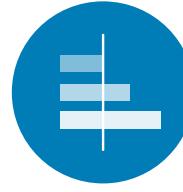
GENERATE IDEAS OR GET FUTURE-READY

Develop ideas for a concept note or review existing plans and projects across the different stages of the project cycle.



CREATE A VISION

Create a desirable vision for your project/team, generating agreement on a preferred future state.



DEVELOP A STRATEGY

Build forward-looking strategies and policies, mapping out pathways toward their possible realization.

How to Use This Document

The report suggests different “routes” depending on your role and responsibilities.

ARE YOU RESPONSIBLE FOR TRANSPORT STRATEGY AND POLICY?

The section *Alternative Approach to Planning and Designing Transport Projects* would be a good place to start. It describes a variety of visions of what your transport strategy could look like in the year 2050. You may want to explore these visions as a foundation for your own foresight journey. This approach lets you identify issues to elaborate on and apply them to your context.

ARE YOU RESPONSIBLE FOR THE DESIGN AND IMPLEMENTATION OF TRANSPORT PROJECTS?

Begin with a review of the *Alternative Approach to Planning and Designing Transport Projects* section. Our collection of trends and visions can jump-start your futures thinking by giving you a framework to begin your exploration.

Learn about the broader development context in which your project will need to perform by exploring the trend cards and the visions framework. You can then contextualize and expand it with other sector and thematic considerations, as well as other dimensions that could matter to your project and its stakeholders. Building on this visioning process you might want to proceed by identifying the most plausible and practical pathways toward your (or your project stakeholder’s) desired future. A participatory approach will help you expand your ability to scan and unearth emerging issues, weak signals, and trends that may disrupt your project later or unearth hidden opportunities.

ARE YOU INTERESTED IN HOW TRANSPORT INTERACTS WITH OTHER SECTORS OR DEVELOPMENT THEMES?

Our study highlights the interconnections between transport and other thematic or sector aspects. This is reflected in our trends, visions, and principles. Use this report as a starting point to launch your own futures thinking and foresight exercise to explore how transport is likely to change and what it means for you—whether your focus is on agriculture, rural development, urban poverty, aging populations, or something else.

Plausible Visions for Future Transport in Asia and the Pacific

VISIONS; DEFINING YOUR PREFERRED FUTURE

Building on the 10 trends, a set of 8 vision statements has been developed to inspire practitioners with alternative futures in the year 2050. Each vision has been defined as an aspirational statement of what an ideal future transport system could look like. The visions have been intentionally written as ambition statements to encourage project developers and decision-makers.

Due to the contextual differences that exist between developing countries in Asia and the Pacific, different visions are expected to be more or less relevant. Of course, the degree of interest to adopt each vision may vary based on actors' views of the things they want to change, influence, respond to, and improve. This underlines the importance of a participatory approach to ensure key stakeholders are involved in the selection of visions to apply, and to avoid blind spots in the design of future strategies and projects.

Four **principles** have been identified to support the achievement of each vision (Figure 2). These are intended to guide project developers on the design of national strategies, sector strategies, policies, and projects in alignment with the selected 2050 vision.

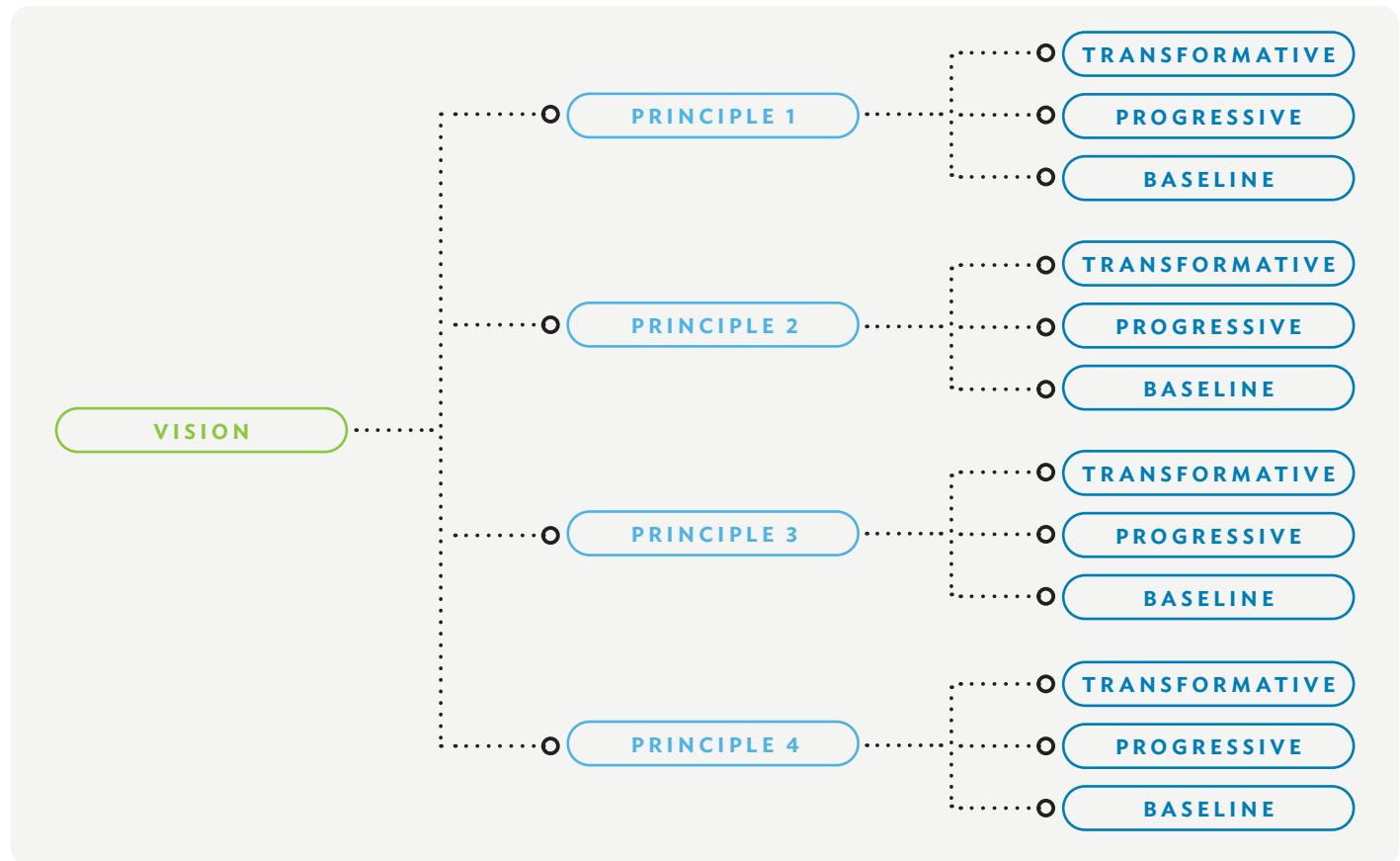
A range of **strategies** have been developed to support practitioners in thinking about the levels of ambition they wish to achieve, through selection of the relevant visions and principles (Figure 2). Alternatively, they may also develop desired futures and ambitions building on ideas from the visions framework. To ensure relevance, considering different development and readiness among countries, three levels of incremental strategies

have been established: baseline, progressive, and transformative. *Baseline* strategies present basic levels of ambition that a country or practitioners should adopt; *progressive* strategies will push the boundaries of what is possible; and *transformative* strategies represent the most innovative ideas. Due to the rapid development and evolution of technologies, these strategies should not be viewed as an exhaustive set of recommendations—but rather a starting point to inspire practitioners and project teams to embark on their own foresight journeys to develop future-ready strategies and projects.

The set of visions, principles, and strategies has been drafted to address the multifaceted challenges in the range of trends impacting transport. Notably, *trends* and *visions* do not align one to one. Rather, due to the cross-cutting nature of the issues and challenges, each vision could be built on multiple trends, with some acting as the main drivers and others with more passive influence. Nevertheless, three specific trends have been identified as key drivers for each vision. Crucially, ADB's existing Strategy 2030 Operational Priorities, as well as Quality Infrastructure Principles, inform the design of this approach to planning and investments. The approach aims to consolidate these priority drivers into this single point of reference to shape the future of transport.

The eight vision frameworks are presented within section 6. Figure 3 lays out the structure of these tables. For each vision, incremental strategies are presented in horizontal rows, to support the four principles across the columns. This vision framework ultimately intends to show countries in the region and ADB what a plausible future might look like, to help consider strategies to achieve selected visions.

FIGURE 2: VISION FRAMEWORK



Source: Authors.

FIGURE 3: VISION TABLE TEMPLATE

VISION 2050	BASELINE	PROGRESSIVE	TRANSFORMATIVE
PRINCIPLE 1	Strategies to achieve		
PRINCIPLE 2			
PRINCIPLE 3			
PRINCIPLE 4			

Source: Authors.

Summary

These are the eight visions and associated principles:



VISION 1

Safe, reliable, and efficient systems

Future transport systems will deliver safety across transport modes, reliability, and efficiency outcomes for all users, to promote shared and active modes while delivering transport that is convenient and user-friendly.



VISION 3

Deliver resilient transport infrastructure systems

Future transport systems are planned, designed, and operated to steer developing countries and Asia and the Pacific toward low-carbon and resilient development.



VISION 2

Inclusive and accessible spaces and services

Future transport infrastructure and systems will catalyze the development of more inclusive spaces and services that are accessible, safe, and affordable for all users.



VISION 4

Seamless transport and logistics systems

Future transport systems are fully integrated transport and land use plans that deliver compact and connected developments that bring people, businesses, and goods closer together. Seamless connections across modes offer efficient end-to-end journeys.



VISION 5

Deliver environmentally considerate outcomes
Future transport infrastructure and systems will deliver environmentally considerate outcomes that go beyond mitigation to enable transport to support restorative and regenerative ecosystems.



VISION 7

Technology-enabled transport services
Future transport infrastructure and systems must embrace and adopt mobility innovations driven by clear outcome-led planning to address specific social, environmental, and economic issues and aims.



VISION 6

Robust institutional, financial, and technical capacity
Future transport infrastructure and systems will be underpinned by stakeholders, champions, and leaders able to plan, deliver, monitor, and manage transport functions in the long term. They will have the required governance, technical capacity, and willingness to collaborate, and will use innovative funding and financing mechanisms and partnerships. They will also have the legislative and regulatory frameworks available to enforce good governance.



VISION 8

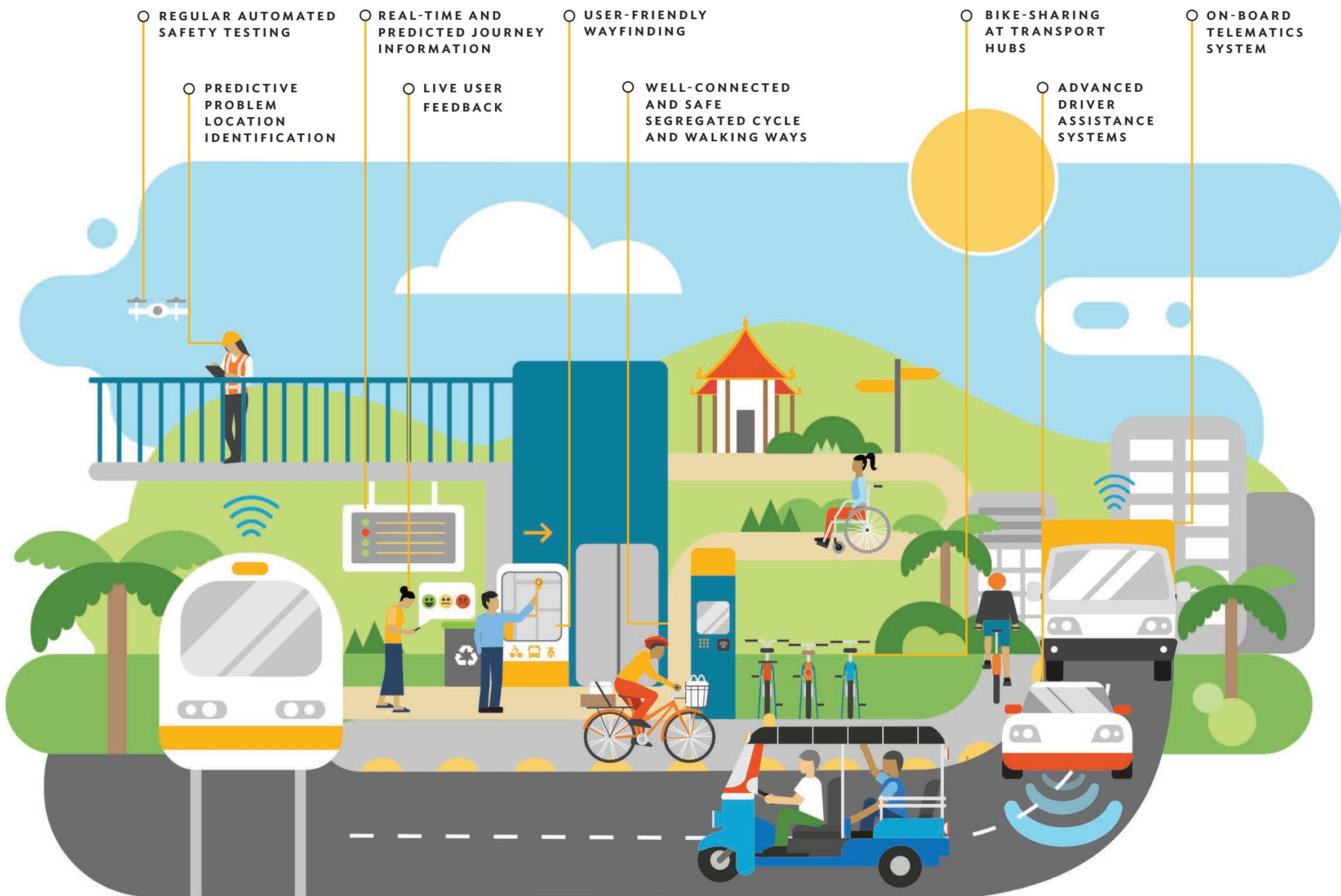
Strong regional cooperation and comprehensive development
Future transport infrastructure and systems will be crucial in supporting regional cooperation and collaboration to deliver multimodal strategic transport connectivity and facilitate critical economic corridors. This will deliver big picture benefits across Asia and the Pacific.



Vision 1

Safe, Reliable, and Efficient Systems

Future transport systems will deliver safety, reliability, and efficiency for all users, to promote shared and active modes while delivering convenient and user-friendly transport.



2050 strives for predictable, safe, and well-utilized multimodal transport systems within a network of connected and integrated modes that provide clean, safe, and well-maintained options.

Roads and railways are efficient. Segregated pathways provide safe access for pedestrians and cyclists. International gateways that are safe, efficient, and reliable facilitate movement of passengers and cargo.

Transportation networks are beholden to their users: owners, transport users, and logistics customers. Stakeholders are involved in decision-making—extensive public consultation is used to inform more inclusive and user-centered design strategies. Technologies both improve operations and facilitate real-time user feedback on journeys, helping to create environments of accountability and responsibility. Good utilization of technology increases efficiency through provision of real-time travel information and journey planning for users. It also helps monitor quality and consistency across modes.

Safety is paramount for people to fully utilize public and active transport. In 2050, systems are well-maintained and regularly tested, supported by policy and regulation which address mode safety and behavior. Automation is used to deliver better performance in safety, maintenance, and operations.

TABLE 1: VISION 1 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
 PRINCIPLE 1 <i>User-friendly transport systems</i>	<p>PHYSICAL WAYFINDING Clear and well-maintained physical wayfinding signage,^a reliable one-way information flow,^b basic support provision and light engagement with users to understand their needs.</p>	<p>TWO-WAY INFORMATION FLOWS Clear wayfinding and digital signage, two-way information flow during trip, open-source and transparent data, enhanced support provision and moderate engagement with users during trips to better understand their needs.</p>	<p>REAL-TIME AND AUGMENTED WAYFINDING AND FEEDBACK Two-way information flow before, during, and after trips, with real-time and augmented user support and feedback using digital devices, engagement with a wide range of users and non-users (including hard-to-reach and vulnerable users) to understand their needs.</p>
 PRINCIPLE 2 <i>Ensure integrated, safe, and robust design across modes</i>	<p>INTEGRATED PHYSICAL AND NON-PHYSICAL MEASURES Hard measures (i.e., physical infrastructure and engineering design standards) and soft behavioral measures (non-physical infrastructure such as awareness and education campaigns, institutional capacity building to increase enforcement, policy, etc.) are in place to address safety across transport modes.</p>	<p>TECHNOLOGY-ASSISTED SAFETY Driver Assistance Systems and use of telematics for transport management and planning. Stress evaluations performed on most frequent trips and enhanced design of roadways to accommodate different transport mode users.</p>	<p>PREDICTIVE SAFETY MANAGEMENT SYSTEMS Predictive problem location identification, onboard telematics and real-time feedback to operators and users with relevant measures across all modes (public transport, road, rail, water transport, etc.). Using digital twins to predict safety risks of trends.</p>
 PRINCIPLE 3 <i>Deliver efficient, maintainable, and predictable systems</i>	<p>DATA DRIVEN REAL-TIME SYSTEMS Real-time information available to users and operators with one-way data flow (not influencing demand), use of manual preventive maintenance processes, and incident response plans.</p>	<p>DEMAND-RESPONSIVE AND SMART SERVICES Create demand-responsive transport services using two-way real time information flow using passive information (sensors) and active information (intentional human responses), influencing demand and delivering real-time feedback on conditions and performance.</p>	<p>PREDICTIVE DEMAND MANAGEMENT Predictive timely information for users integrated with demand management (i.e., adaptable pricing) and real-time operations. Open-source and fully transparent information sharing using digital twins, also allowing automated monitoring for maintenance, thereby improving lifecycle costs.</p>
 PRINCIPLE 4 <i>Promote and enable safe active mobility options</i>	<p>ACCESSIBLE WALK- AND CYCLE WAYS Improved walking and cycling facilities through promotion of segregated pathways. Active mobility is easily accessible, cycling facilities are offered at transport hubs, and bike shares include integrated payment systems.</p>	<p>REALLOCATION OF ROAD SPACE AND RETROFITTING EXISTING INFRASTRUCTURE Conversion of limited urban roadways and lanes for active transport. Use policy to promote a culture of active mobility promoting health benefits.</p>	<p>FULLY INTEGRATED CYCLING AND WALKING INFRASTRUCTURE Integration of connected and protected active mobility pathways within the overall transport network that are well-connected (i.e., pedestrian and cycle networks) and safe (i.e., barriers between car and walking paths).</p>

^a Information systems that guide people through a physical environment and enhance their understanding and experience of the space. Comprehensive wayfinding systems often combine signage and symbols and increasingly integrate mobile applications, digital displays, and other wireless technologies.

^b In a one-way interface, the information flows unilaterally (i.e., a train operator updating its customers of delays) whereas in a two-way interface, the receiver has the opportunity to give feedback and/or to question what has been said and add details to it.

Case studies



AUTOMATED UNDERGROUND BICYCLE PARKING AT KYOTO STATIONS

Kyoto, Japan^{6,7}

The initiative was developed with the concept of “Culture Aboveground, Function Underground.” With a compact entrance booth, it requires minimal space aboveground, provides more than 200 parking spaces underground, promotes the use of the bicycles, and prevents disorderly parking.



WALK2RIDE SCHEME

Singapore⁸

Under Singapore Land Transport Authority’s Walk2Ride Scheme, more than 200 kilometers (km) of sheltered walkways were added around the island, making walks to mass-rapid transit stations and bus interchanges rain and sun protected. These covered walkways strengthen connectivity networks around mass-rapid transit stations and better connect trip generation hubs (commercial, residential, entertainment).



EMERGENCY BOGOTA BIKE LANE EXPANSION

Bogota, Colombia^{9,10}

Early in the global coronavirus pandemic, the mayor of Bogota repurposed vehicle lanes to open 76 km of temporary bike lanes, increasing capacity by 14%, to offer a “hygienic alternative” to mass transit in the Colombian capital. While instigated as a direct response to the pandemic, the expansion demonstrates the impact of political decisions on instant changes in urban transport, behavioral change, and emissions reduction.

⁶ Giken. Automated Parking Facility ECO Cycle.

⁷ Giken. 2013. Hachijoguchi West and Hachijoguchi East Bicycle Parking Areas of the Kyoto Station. Eco Cycle.

⁸ Government of Singapore, Land Transport Authority. 2015. A More Comfortable Walk to Your Ride by 2018.

⁹ S. Wray. Bogotá Expands Bike Lanes to Curb Coronavirus Spread. *Smart Cities World*. 18 March.

¹⁰ C. Reid. 2020. Generously Fund Cycleways, Experts Say As Covid-19's Spread Boosts Bicycle Use. *Forbes*. 22 March.

Related Trends and Principles

TABLE 2: UNDERLYING TRENDS*Behavior Patterns*

Future mobility innovations and other drivers of change such as COVID-19 are changing the way people live, work, and move. In certain developing countries in Asia and the Pacific, transport users are observed to be shifting toward more sustainable lifestyles (e.g., active mobility). It is crucial to ensure the countries sustain such behavioral shifts to low-carbon and inclusive modes.

Integrated Transport Systems

To enable structured urban growth and economic development and enhance social well-being, urban transport systems need to offer safe and efficient alternatives to other, more-polluting modes.

Adaptive Infrastructure Planning

Built environments should be designed to meet evolving demands of growing populations and new behavioral patterns. This could be achieved through retrofitting, repurposing, or delivery of new infrastructure to achieve sustainable growth that works for everyone.

TABLE 3: ADB STRATEGY 2030 OPERATIONAL PRIORITIES (OP)

OP1: Addressing remaining poverty and reducing inequalities

OP2: Accelerating progress in gender equality

OP7: Making cities more livable

TABLE 4: QUALITY INFRASTRUCTURE PRINCIPLES

Raising economic efficiency in view of life-cycle cost

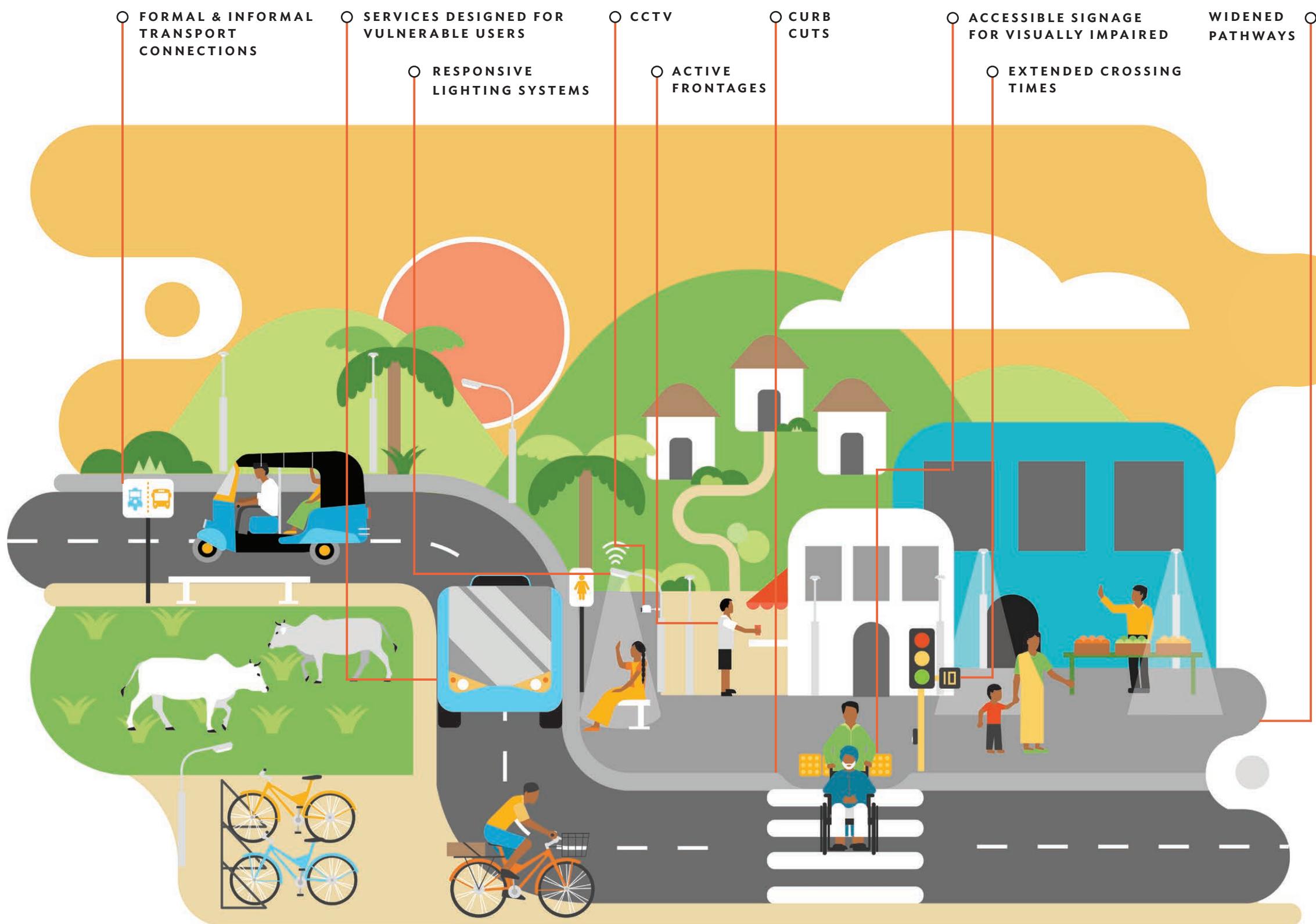
Integrating social considerations in infrastructure investment



Vision 2

Inclusive and Accessible Spaces and Services

Future transport infrastructure and systems will catalyze the development of spaces and services that are accessible, safe, inclusive, and affordable for all users.



2050 is a world where all people can access, afford, and feel safe while traveling.

Access: Transport systems deliver pleasurable experiences for all communities across gender, age, mobility, and other characteristics, and greater access supports poverty reduction. Affordable transport enables better access to employment, livelihoods, and services.

Affordability: Greater mobility, including cycling infrastructure, offers affordable transport over short distances, and long distance travel is likewise affordable and better connects rural populations who do not always have access to paved roads.

Safety: Personal safety for all must be fundamental; this includes safety onboard transport, in active transport environments, and in first and last-mile connectivity. For example, improvements to lighting and closed-circuit television help reduce the risk of crime. Technological advances, such as in AI, could also play a growing role in personal transport safety, although this will need to be balanced against privacy concerns.

In short, accessibility is a foundation of inclusive environments and must be considered across infrastructure and modes and all incomes, ages, and vulnerable users. Changes to design and the inclusion of digitization, sensors and technologies aid vulnerable users and assist in navigating the wider built environment. Digital inclusion of vulnerable groups promotes collective growth and competitiveness.

TABLE 5: VISION 2 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
	PRINCIPLE 1 <i>Integrate formal and informal transport networks</i> <p>IMPROVE PHYSICAL NETWORKS Improve connections between formal and informal transport networks to enhance accessibility. Improve the quality of informal transport networks (i.e., upgrading the material used on paths, roads, and bikeways).</p>	<p>IMPROVE END-TO-END JOURNEYS Develop a common platform or forum for formal and informal transport providers to identify and improve gaps in service.</p>	<p>FULLY INTEGRATED END-TO-END JOURNEYS Deliver integrated planning that better connects formal and informal transport systems to deliver more inclusive and enhanced accessibility for all.</p>
	PRINCIPLE 2 <i>Guarantee personal safety on and around public transport for all</i> <p>SAFER TRANSPORT DESIGN FOR ALL Improve street lighting and crime prevention features (i.e., removal of blind corners on streets) to ensure safety of vulnerable groups both in the public realm and in public transport.</p>	<p>ACTIVE FRONTEAGE Utilize integrated transport and land use planning to promote “active frontage” on key pedestrian routes, and promote public transport ridership to increase capacity and oversight of the system.</p>	<p>RESPONSIVE ENVIRONMENTS Create responsive and safer environment (i.e., active lighting or artificial intelligence-based systems to warn pedestrians of danger). Incorporate safe design from the start of all new transport projects.</p>
	PRINCIPLE 3 <i>Inclusive and affordable choices for vulnerable users</i> <p>UPGRADE INFRASTRUCTURE Improve and upgrade infrastructure in lower-income regions and disadvantaged groups.</p>	<p>AFFORDABLE CHOICES Provide affordable travel options and enhance transport connectivity between lower-income and disadvantaged areas with economic centers.</p>	<p>TRANSPORT FOR ALL Promote community-based and shared transport for all user groups—including women and vulnerable users—enhancing connectivity for lower income and disadvantaged users to economic centers, for more equitable access to opportunities.</p>
	PRINCIPLE 4 <i>Ensure physical accessibility</i> <p>UNIVERSAL DESIGN Apply universal design standards for all transport infrastructure and services (i.e., adequate pedestrian crossing time, ramps and curbs on streets, level boarding on trains and buses).</p>	<p>RECONFIGURED PATHWAYS Roads are reconfigured to accommodate different user groups. This may include accessible signage for the visually impaired, for example, or longer signal times for slower walkers and wider pedestrian pathways for wheelchairs.</p>	<p>ADAPTABLE RESPONSIVE MOBILITY Transport systems are responsive, flexible, and adapted to a variety of present and future needs. Pedestrian friendly, permeable, and compact urban environments, for example, assistive services will help people with disabilities move throughout the city.</p>

Case Studies



IMPROVING WALKABILITY “CAR FREE” ZONES IN VIETNAMESE CITIES

Several cities in Viet Nam¹¹

To address traffic congestion and safety issues for non-motorized transport users, many cities in Viet Nam, including Ho Chi Minh City and Ha Noi, have implemented temporary and permanent “car free” zones. These projects help influence travel behavior, encourage walking and cycling, boost local business, and increase social cohesion by increasing space for community events and play areas.



INNOVATIVE BUS RAPID TRANSIT

Peshawar, Pakistan¹²

Funded by ADB, Agence Française de Développement, and the European Investment Bank, the Peshawar Bus Rapid Transit corridor project will construct the city's first bus rapid transit corridor with 31 stations. It will include bicycle lanes and a range of safety features for women and vulnerable users, such as proper lighting, surveillance, segregated areas, and staff trained to facilitate women commuters. Over 20% of the 4,000 jobs expected to be generated by the project will be for women.



NEW YORK METROPOLITAN TRANSPORT AUTHORITY FLAT FEE FOR ANY DISTANCE

New York, United States¹³

For any distance of travel, New York City offers a flat rate to all passengers on subways and buses (as opposed to London where passengers pay by distance). Metropolitan Transport Authority offers a reduced rate to people with disabilities and those aged over 65.

¹¹ Quang Minh Nguyen. 2016. Application of “Car-Free City” and “City of Short Walks” to Living Quarters in Hanoi Toward Sustainable Mobility and Logistics. *Procedia Engineering*.

¹² ADB. 2017. ADB Provides \$335 Million for Pakistan’s Innovative Bus Rapid Transit System in Peshawar. News release. 12 September.

¹³ MTA. n.d. Everything You Need to Know About Transit Fares and Tolls in New York. <http://new2stg.mta.info/fares>

Related Trends and Principles

TABLE 6: UNDERLYING TRENDS*Population Patterns*

Inclusive transportation systems are crucial for networks to cater to all user groups and provide safe, secure, and affordable transportation for all communities across gender, age, mobility, and other characteristics.

Integrated Transport Systems

An efficient urban transport system can form the foundation of structured urban growth, economic development, and social well-being by integrating all transport modes, informal transport into formal systems, and land use into transport planning.

Advanced Technologies

Advanced digital technologies are transforming how transport systems are managed and used, and if deployed with a user and outcome-led focus could improve future journeys across all modes (e.g., physical accessibility).

TABLE 7: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP1:Addressing remaining poverty and reducing inequalities

OP2:Accelerating progress in gender equality

TABLE 8: QUALITY INFRASTRUCTURE PRINCIPLES

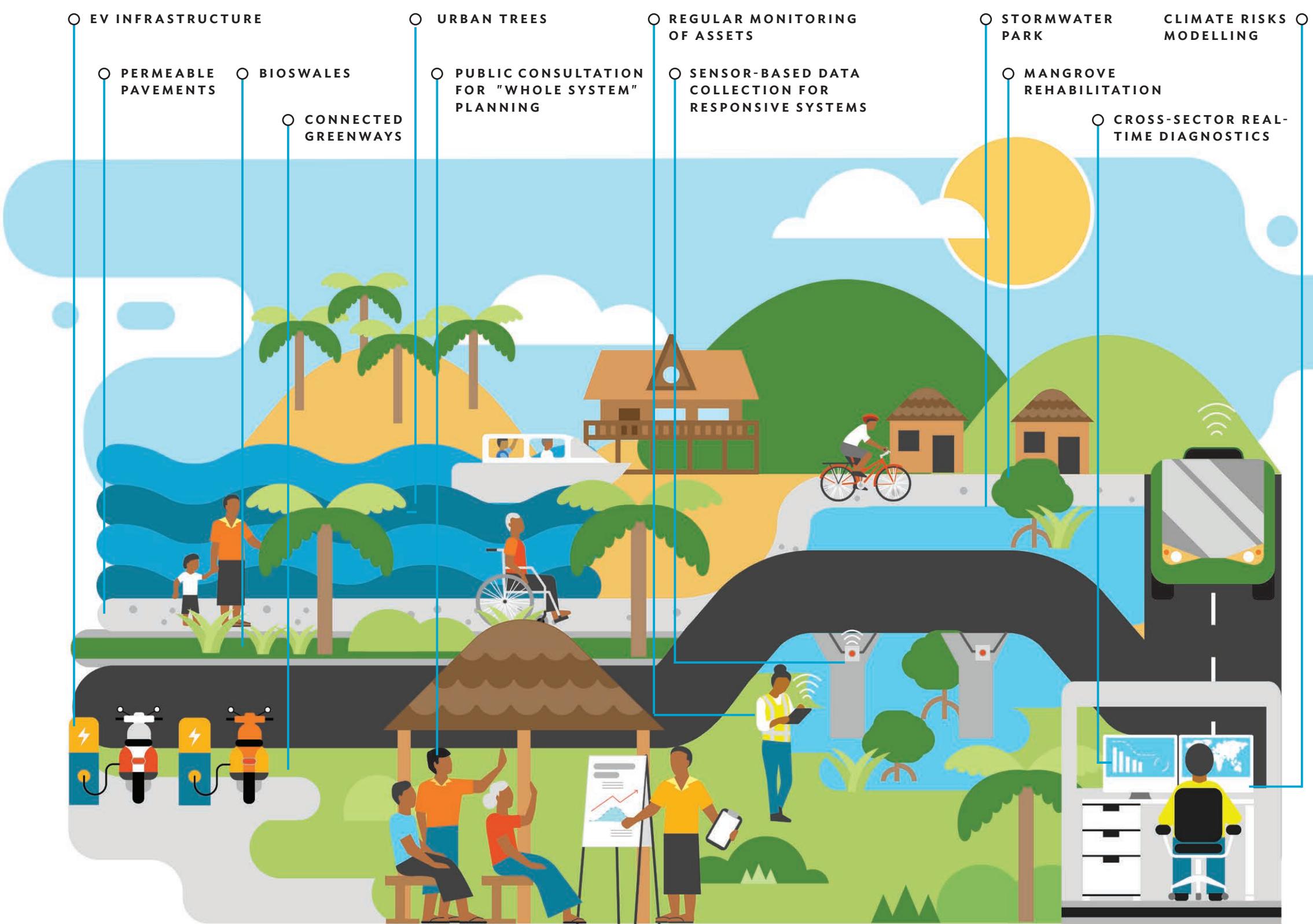
Integrating social considerations in infrastructure investment



Vision 3

Deliver Resilient Transport Infrastructure Systems

Future transport infrastructure and systems are planned, designed, and operated to deliver long-term resilience through a holistic and whole-of-system approach to enable low-carbon and resilient developments.



2050 boasts flexible and integrated transport systems that adapt to changing conditions for resilient outcomes.

Due to climate change, extreme weather events have become more frequent and severe and new threats have emerged, such as extreme heat and sea level rise. However, countries across Asia and the Pacific have increased their capacity to understand and manage a wide range of complex challenges. Emerging technology and novel techniques such as AI, predictive modelling, and sensor-based data collection have enhanced understanding understanding of risks and detection of hazards and climate conditions, and improved the ability of operators and users to respond and adapt.

Resilience is considered in all aspects of planning, infrastructure, services, and operations, supported by long-term engagement between policy makers, investors, designers, and transport users. A strong enabling environment is in place to allow continual improvement of transport system governance, including network planning, design standards, and risk-informed operation and maintenance. Transport systems are robust, flexible, and highly integrated. This protects and enhances livelihoods, minimizes disruption and downtime, allows safe community evacuation, expedites recovery, and ensures continuity of economic activity when shocks and stresses occur. Transport systems contribute toward gray, green, and blue infrastructure.

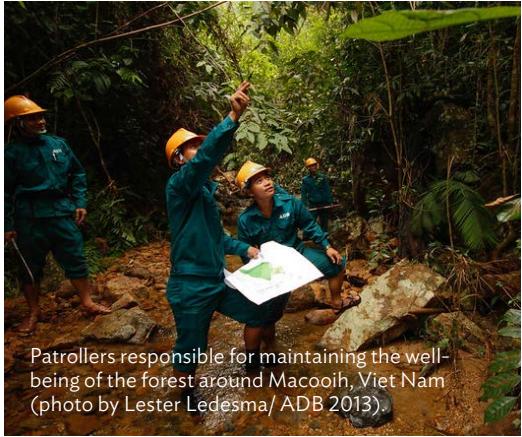
Resilience is achieved through a whole systems approach enhancing integration across sectors; aligning investment with broader goals for human well-being and economic development. Transport sector commitments such as through Nationally Determined Contributions relating to greenhouse gas (GHG) emission reductions and climate-change adaptation have been implemented.

TABLE 9: VISION 3 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
 PRINCIPLE 1 <i>Ensure risk-informed transport system management</i>	PROJECT-LEVEL RISK MANAGEMENT <p>Undertake comprehensive multi-hazard risk assessments to inform selection of projects that support resilient development and to identify risk management measures that strengthen systemic resilience, such as hazard monitoring and early warning systems. Share risk information across sectors, levels of government, and the private sector.</p>	SYSTEM-WIDE RISK MANAGEMENT <p>Undertake upstream planning and system-wide risk assessment to inform project pipelines that steer national development toward resilience. Identify a suite of risk management measures to strengthen transport system resilience to detect risks and cross-sector contingency plans. Integrate spatial climate and disaster risk data with transport operations at all levels.</p>	REAL-TIME DIAGNOSIS AND RESPONSE <p>Utilize real-time monitoring, diagnostics, data analytics, and AI to improve hazard monitoring, complex risk modelling, and to plan for future shocks and stresses. Enhance capacity in developing countries in the region and in the private sector to continually adapt and improve transport and related system operations in response to risk.</p>
 PRINCIPLE 2 <i>Prioritize nature-based solutions and adaptable infrastructure</i>	NATURE-BASED FEATURES <p>Integrate functional nature-based features (i.e., bioswales, raingardens, and natural water retention) to enhance resilience in transport projects and to benefit infrastructure systems and communities. Understand and consider the natural environment that existed prior to the urban environment.</p>	NATURAL SYSTEM RESTORATION <p>Leverage transport projects to restore and enhance natural functions (i.e., watershed, wetland, and mangrove restoration) or retrofit nature into urban environments by strategically creating corridors, nodes, and networks of natural and semi-natural areas (i.e., greenways and nature corridors).</p>	ECOSYSTEM-BASED PLANNING <p>Shift from car-centric design toward designing for multi-users, including vulnerable groups. Plan for holistic and active mobility by prioritizing functional ecosystems and nature-based solutions. Develop incentives, standards, and guidelines that prioritize health, safety, and resilience for wide-scale adoption.</p>
 PRINCIPLE 3 <i>Embed resilience in policies, planning, and governance</i>	INSTITUTIONAL CAPACITY <p>Ensure transport projects include capacity building components to enhance the enabling environment for resilient planning, design, operation, and maintenance.</p>	WHOLE-OF-SYSTEM STRATEGIES <p>Provide strategic upstream support to develop resilient investment pipelines for both government and private sector. Initiatives may include multi-hazard risk assessment and mapping, resilient sector plans and road maps, and developing resilient standards for transport planning, design, and operation.</p>	CROSS-SECTOR TRANSFORMATION <p>Implement structural reforms toward resilient cross-sector governance, in close partnership with the private and public sectors. Implement whole-of-systems approaches for transport resilience, including land use and urban planning, digital systems, and policy incentives.</p>
 PRINCIPLE 4 <i>Design responsive and flexible systems for enhanced resilience</i>	PREDICTIVE MODELLING <p>Use data and predictive modelling to identify and evaluate multi-hazard risks for transport systems and understand potential impacts (i.e., user safety, disruption and downtime, reduced efficiency). Identify flexible resilience solutions that can be adjusted and improved over time.</p>	ADAPTIVE PLANNING <p>Evaluate the dependencies and relationships between transport and wider systems and identify resilience solutions that meet near-term needs while allowing for adaptation, growth, and renewal over the long term to meet changing needs and an evolving risk landscape.</p>	AGILE APPROACHES <p>Based on predictive modelling and scenario building, design agile systems that can reconfigure in response to threats and seamlessly transfer between modes (i.e., from land to air or water). Use adaptation pathways planning to embrace uncertainty and allow flexibility to adapt over time.</p>

Case Studies



Patrollers responsible for maintaining the well-being of the forest around Maccooih, Viet Nam (photo by Lester Ledesma/ ADB 2013).

PATHWAY TO RESILIENT TRANSPORT

Viet Nam¹⁴

The World Bank and University of Oxford Transport Multi-Hazard Risk Analysis for Viet Nam study assessed the vulnerability of Viet Nam's national transport network to flooding and landslides, to inform the prioritization of investments. The study identified resilient national roads, provincial connector assets (i.e., roads and bridges), system-wide multimodal connectivity and network redundancy are cost-effective solutions to enhance resilience.



People relaxing in a public park in Melbourne (photo by Jane Slack-Smith on Unsplash).

MELBOURNE METRO TUNNEL LIVING

INFRASTRUCTURE PLAN

Australia¹⁵

The Melbourne Metro Tunnel project is developing two rail tunnels and five new underground stations through central Melbourne. To integrate eco-based resilience into the design, Rail Project Victoria developed the Metro Tunnel Living Infrastructure Plan which sets out design, implementation, and applied learning solutions to ensure the project results in healthy, resilient, and biodiverse urban landscapes.



Flooding on a street in Kuala Lumpur (photo by Deva Darshan on Unsplash).

KUALA LUMPUR STORMWATER MANAGEMENT AND ROAD TUNNEL

Malaysia¹⁶

The Government of Malaysia completed construction of the Stormwater Management and Road Tunnel (SMART) in 2003. The tunnel switches from a roadway to a stormwater tunnel in the event of flooding, embodying flexibility, a key quality of resilience. The SMART flood management mode has been successfully activated several times, meeting the project's targets for traffic and flood risk management.

¹⁴ J. Eun Oh, X. Espinet Alegre, R. Pant, E. E. Koks, T. Russell, R. Schoenmakers, and J. W. Hall. 2019. Addressing Climate Change in Transport. Viet Nam Transport Knowledge Series. World Bank Group.

¹⁵ Victoria State Government, Melbourne Metrorail Authority, LOCI Environment & Place. 2017. Living Infrastructure Plan. June 2017

¹⁶ Road Traffic Technology. 2004. SMART (Stormwater Management And Road Tunnel), Kuala Lumpur, Malaysia.

Related Trends and Principles

TABLE 10: UNDERLYING TRENDS

Climate Change and Disaster Risk

Driven by increasing climate and disaster impacts, international agreements, and rapidly evolving national climate policy, the imperative is growing for developing countries in Asia and the Pacific to build resilience to a changing climate.

Environmental Risks

Increasing global recognition of the role of nature-based solutions as a central planning and design feature to enhance the ability of transport systems, wider infrastructure, and communities to absorb impacts such as flooding, erosion, heat stress, and pollution.

Advanced Technologies

Technological advances can enhance the operation and maintenance of transport systems by modelling, detecting, and predicting climate and disaster impacts, and allowing systems and their users to respond and adapt in real time.

TABLE 11: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP3:Tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability

OP4: Making cities more livable

TABLE 12: QUALITY INFRASTRUCTURE PRINCIPLES

Integrating environmental considerations in infrastructure investments

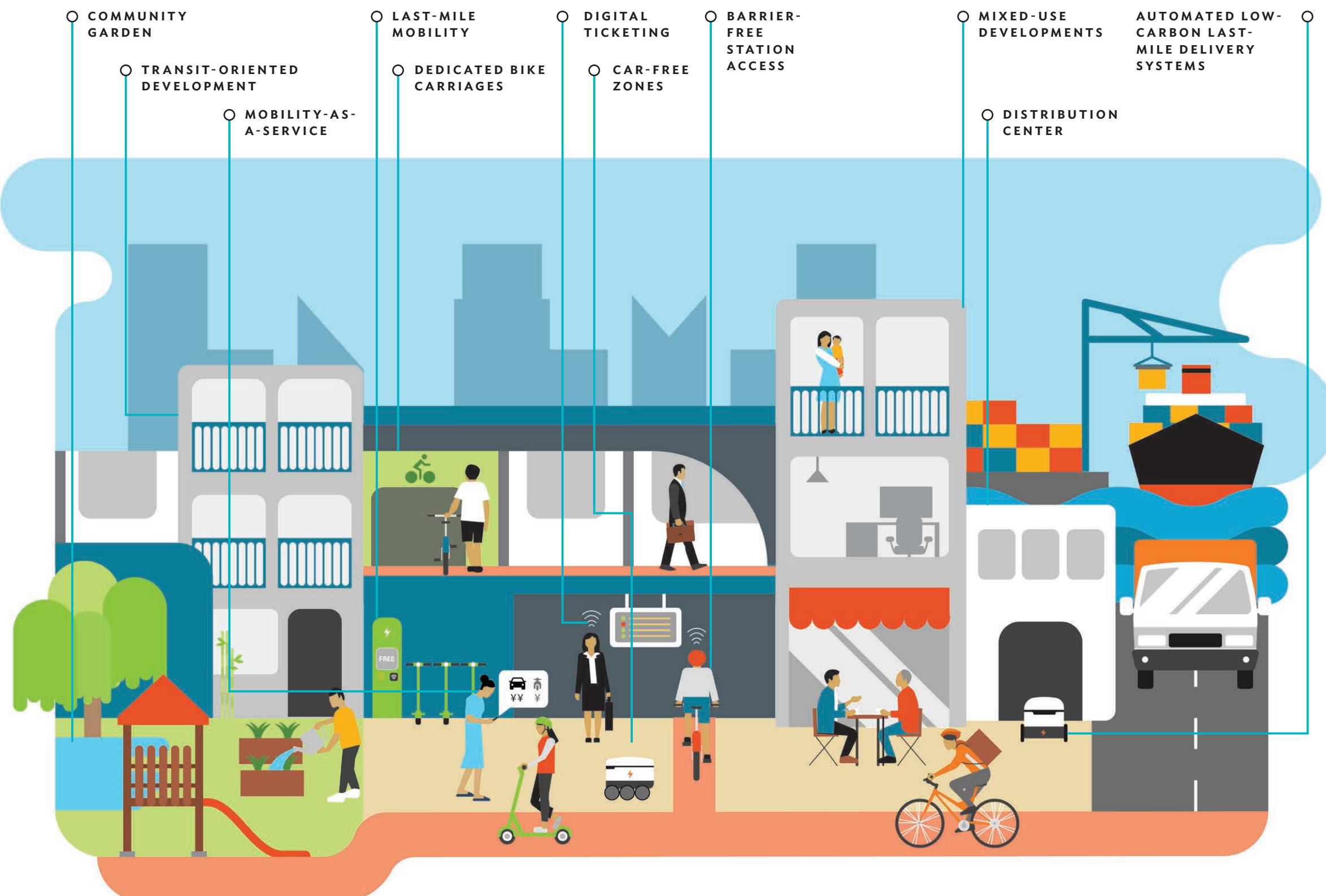
Building resilience against natural disasters and other risks



Vision 4

Seamless Transport and Logistics Systems

Future multimodal transport will be central to fully integrated transport and land use plans to deliver compact and connected developments and that bring people, business, and goods closer together. They will offer seamless connections across modes for efficient, end-to-end journeys.



In 2050, mobility systems are seamlessly integrated throughout neighborhoods, cities, and regions, enabling ease of travel and ensuring people and goods are connected to the places they need to go.

An integrated approach to planning, development, and transport forms the foundation of economic development and social well-being by connecting people to livelihoods, services, and communities. Planning for transport infrastructure aims to provide accessibility of services and goods as a means to wider societal needs, not an end in itself. This vision recognizes national and local planning as a “coupled” process involving consideration for transit-oriented development and accessibility for all transport users, including vulnerable users.

Transport solutions must be context-specific and designed to meet sustainable development principles. Districts aim for optimum density and are connected via public and active transport. Mixed use development shortens travel journeys and facilitates more economically diverse neighborhoods that promote equity.

Innovation has an important role to play in enhancing accessibility, including the availability of new modes for first and last-mile mobility (i.e., ride sharing and scooters), active transport infrastructure (i.e., bike-sharing), mobility-as-a-service, and general technological advancement in automation, electrification, and digitization.

TABLE 13: VISION 4 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
 PRINCIPLE 1 <i>Integrate land use and transport planning</i>	TRANSIT-ORIENTED DEVELOPMENT <p>Promote and deliver higher density land use (i.e., employment, housing, retail) around major public transport and active mobility nodes and showcase best practice areas to build momentum for wider rollout.</p>	LOCAL SERVICES AND TRAVEL PATTERNS <p>Implement transit-oriented development and active mobility to promote “live local” concept (i.e., 15-minute neighborhoods that reduce the distance of travel). Locate low-density and car-dependent land uses away from dense corridors.</p>	DESIGNED FOR DESIRABLE DENSITY <p>New and retrofitted areas are designed to maximum desirable density and are transit-oriented with low and no-car use. New low-density areas are not permitted in urban centers. Implement policies to incentivize reduced trip length and frequency.</p>
 PRINCIPLE 2 <i>Plan for integrated and multimodal logistics</i>	CONNECTED MULTIMODAL NETWORKS <p>Logistics network planned and designed as integrated systems across modes with sufficient capacity (i.e., distribution, warehousing, dry ports, gateways, etc.). Integration of cross-border logistics, inter-city logistics and urban logistics that facilitates first and last-mile delivery).</p>	SYNCHRONIZED MULTIMODAL NETWORKS <p>Synchronized logistics network with horizontal integration between manufacturers and service providers, and among service providers themselves, in bundling their flows to allow the use of shared transport assets and services. Consolidated logistics for inner city distribution.</p>	SEAMLESS MULTIMODAL SOLUTIONS <p>Logistics and reverse logistics are fully integrated and consolidated across all modes (including new modes such as hyperloop, drones, space freight transport, sail ship, and underground transport), with multiple interchange points on the network enabling all journeys to be made efficiently. Transparent information made readily available to all users allowing for optimal capacity utilization.</p>
 PRINCIPLE 3 <i>Deliver seamless connectivity across all passenger transport modes</i>	CONVENIENT LOCAL PASSENGER CONNECTIVITY <p>Physical interchanges between passenger transport modes are well integrated, efficient, and safe, with reliable information on transport connections.</p>	INTEGRATED PASSENGER CONNECTIVITY <p>Multimodal passenger transport network is highly accessible and covers most areas of cities/towns and is connected at key nodes, with connections between modes enabling people to primarily use public and active transport options. Reliable and timely travel information is provided to users. Payment systems across transport modes are integrated.</p>	UNIFIED PASSENGER SYSTEMS AT DOMESTIC AND REGIONAL LEVEL <p>The multimodal transport network offers maximum accessibility and connectivity and operates as an integrated whole system, with interchange enabled by seamless digital payment/ticketing (i.e., mobility-as-a-service), high quality interchange design and travel information made readily available to users.</p>
 PRINCIPLE 4 <i>Promote investments that deliver social benefits for all users</i>	AVOID DISPLACEMENT <p>Designers and decision makers work with communities to “do no harm,” accelerate progress in gender equality and avoid physical displacement of residents (i.e., demolition of homes).</p>	COMMUNITY COHESION <p>Ensure adequate active and accessible transport options for all transport users. Assess social value for all new and retrofit developments considering benefits to the community beyond economic factors. For example, greater community cohesion or improved employment rates.</p>	DATA-INFORMED DESIGN <p>Use of data and insights to inform design and build transport infrastructure in regions of low income and disadvantaged groups. This approach can help unlock access to jobs and education and improve well-being of residents and transport users (i.e., reduce journey time and safe travel).</p>

Case Studies



TRANSIT-ORIENTED DEVELOPMENT

Tokyo, Japan¹⁷

The Tsukuba Express Project embodies the development of public transport systems with housing along the line under an integrated development law. The project realized the construction of a railway system while changing the share of public transport systems used by residents. Recently, "bus and train rides" combining the use of the Tsukuba Express with highway bus services have formed a multimodal transport network for the area.



LAND TRANSPORT MASTERPLAN 2040

Singapore¹⁸

The 2040 Land Transport Masterplan objectives are supported by specific and measurable targets to drive transport management: 75% of journeys to be made on public transport; 85% of journeys of less than 20 kilometers to be completed in less than 60 minutes; and 80% of households living within a 10-minute walk of a train station.



INTER-MODAL DATA-SHARING PROGRAM

Hong Kong, China¹⁹

This public policy research initiative led by Hong Kong University is looking at practical use-cases for operational efficiency, smarter city management, and mobility-as-a-service through data sharing between different stakeholders (i.e., transport operators). The university's Department of Urban Planning and Design is offering a "data trust" for computer simulation. A first use-case workshop looked at the Hong Kong Exchange Square Public Transport Interchange.

¹⁷ I. Kawaguchi. A Case of Transit-Oriented Development in the Tokyo Metropolitan Area Aimed at Multimodal Urban Transportation "Tsukuba Express Project" for Integrated Urban Transport and Housing Development. *Routes/Roads*. 373.

¹⁸ Government of Singapore, Land Transport Authority. n.d. Land Transport Masterplan 2040.

¹⁹ TPRC. 2019. Inter-Modal Transport Data Sharing in Hong Kong: Workshop on Exchange Square Smart PTI Challenge. 23 December.

Related Trends and Principles

TABLE 14: UNDERLYING TRENDS*Population Patterns*

Inclusive transportation systems are crucial for networks to cater to all user groups and provide safe, secure, and affordable transportation for all communities as well as to deliver social benefits.

Behavior Patterns

Worldwide, rapidly advancing digital economy (e.g., e-commerce) in the region will provide additional access to the previously unserved and deliver on consumer demands for convenience and efficiency but will also come with its own set of challenges.

Integrated Transport Systems

An efficiently integrated transport system is a matter of both integrated land use and transport planning and integrated modes (e.g., mobility-as-a-service) but is also a matter of ensuring access to all (including physical and financial access).

TABLE 15: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP4: Making cities more livable

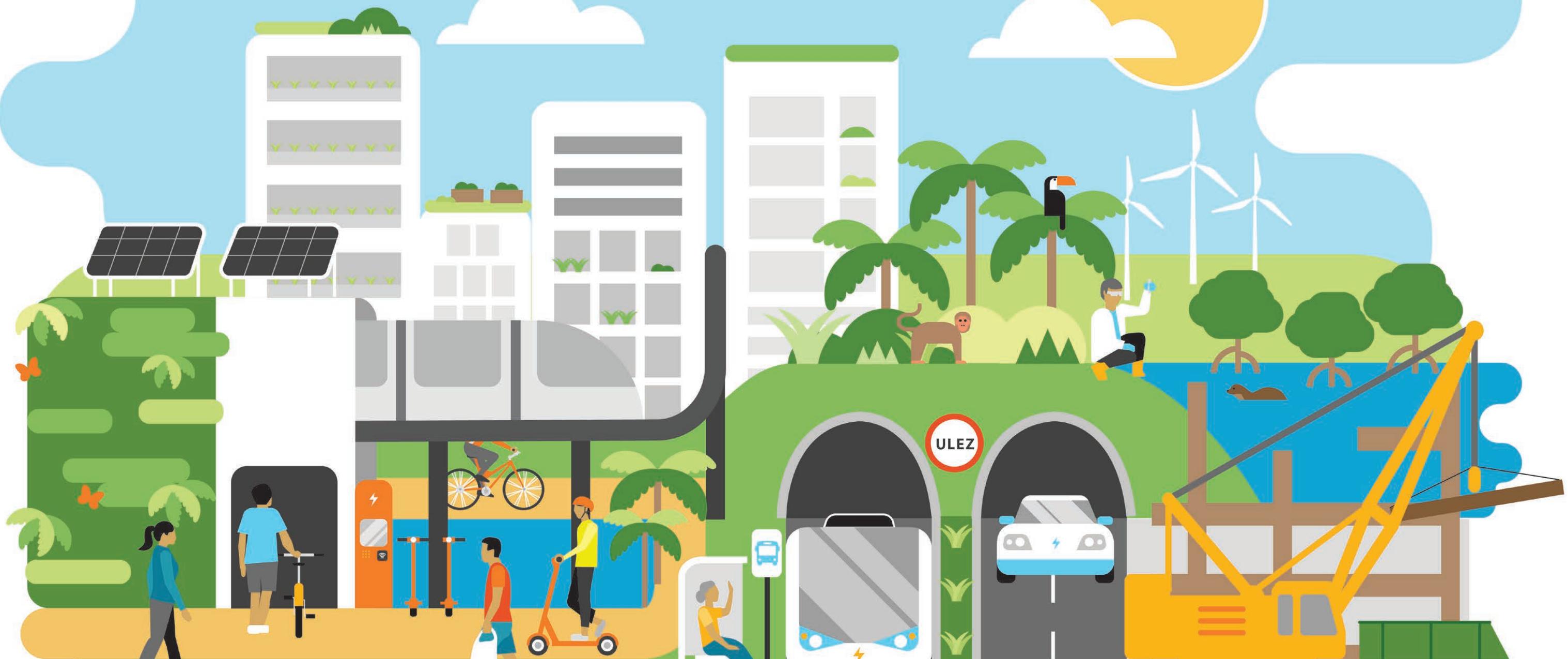
OP5: Promoting rural development and food security

OP7: Regional cooperation and integration

TABLE 16: QUALITY INFRASTRUCTURE PRINCIPLES

Maximizing the positive impact of infrastructure to achieve sustainable growth and development

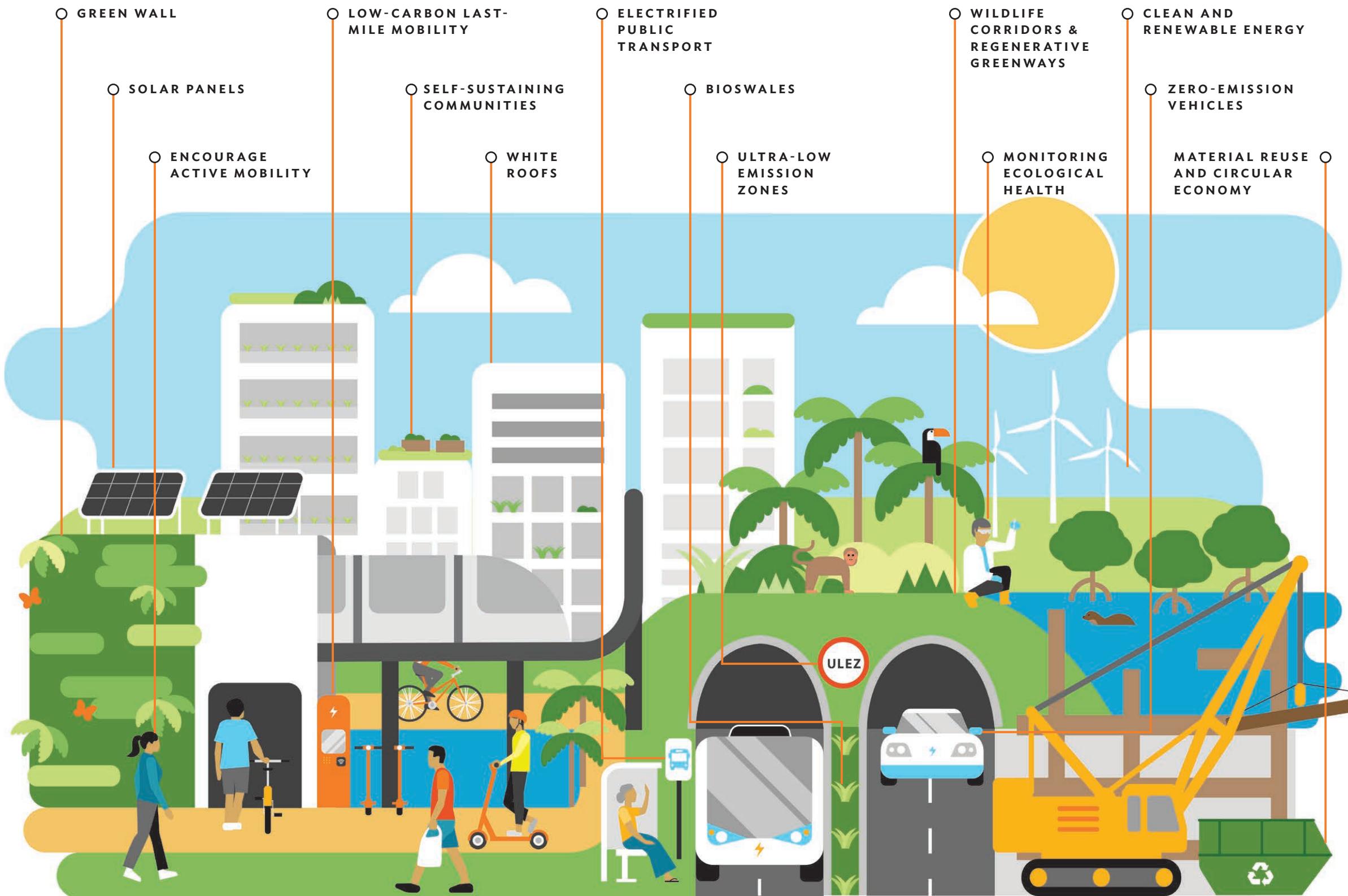
Integrating social considerations in infrastructure investment



Vision 5

Deliver Environmentally Considerate Outcomes

Future transport infrastructure and systems will deliver environmentally considerate outcomes that go beyond mitigation to enable transport to support restorative and regenerative ecosystems.



2050 transport systems run on clean and renewable energy, consider circularity and resource consciousness design, and deliver positive ecological outcomes.

This vision recognizes that the planning, design, construction, and operation of transport systems are critical to ensuring the sustainable use of energy and resources and to meet the mitigation targets set. Regenerative design principles limit negative impacts on air, water, and land and restore natural ecosystems.

In 2050, solutions to enhance system connectivity respect the environment and encourage sustainable consumption. An emphasis is placed on green and renewable technologies, enabling healthy and active transport choices, applying nature-based solutions, and minimizing the destruction of biodiversity and natural resources. Transport systems and strategies are context specific, considering local physical environment, materials, climate, risks, and needs. GHG mitigation measures are implemented through structural reforms to promote transport mode shifts, improve energy efficiency, and reduce fuel carbon intensity, which contribute to a carbon-neutral world.

Global climate agreements and green economic development rely on healthy terrestrial and aquatic ecosystems to promote sustainable livelihoods. Reducing GHG emissions and pollution, promoting nature-positive solutions, and biodiversity considerations, underpinned by technology and automation, will allow more seamless transport experiences and improved well-being for people while delivering positive outcomes for nature.

TABLE 17: VISION 5 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
	<p>PRINCIPLE 1 <i>Accelerate low-carbon development</i></p> <p>LOW-CARBON DEVELOPMENT Develop transport sector plans and road maps to inform inclusive low-carbon development programming opportunities with air quality and health co-benefits, including low-cost renewable energy and energy efficiency improvements.</p>	<p>LOW-CARBON SYSTEMS PLANNING Undertake strategic systems-wide planning for investment pipelines that accelerate progress on GHG emissions reduction and provide co-benefits for air pollution, health, and inclusions. Prioritize mode shift to active travel and public transport, electrification of road-based vehicles, and urban logistic modes, transition to zero-emission vehicles, and uptake of low-carbon fuels.</p>	<p>CARBON-NEUTRAL INCLUSIVE TRANSPORT SYSTEMS Implement cross-sector reforms to decarbonize transport systems (i.e., regulation and incentives for a fully electric or hydrogen-based transport network). Achieve net-zero GHG emissions with significant reduction in air pollutants and related illnesses. Implement policy for self-sustained communities to reduce long-distance travel.</p>
	<p>PRINCIPLE 2 <i>Invest in natural capital and maximize ecological gain</i></p> <p>MITIGATION OF ECOLOGICAL IMPACTS Ensure harmonized, standardized, and rigorous approaches to ecological impact assessments (i.e., supplemental to IFC PS6^a and similar), with comprehensive application of the mitigation hierarchy.^b</p>	<p>NO NET LOSS OF NATURAL CAPITAL Achieve no net loss of biodiversity and ecosystem services with new infrastructure projects, including biodiversity offsets, through implementation of the mitigation hierarchy, new projects demonstrate that overall gains in biodiversity are equal to the loss.</p>	<p>NET GAIN IN NATURAL CAPITAL Achieve net gain in biodiversity^c and ecosystem services across projects through avoidance of ecologically sensitive areas and integration of regenerative design principles (i.e., greenways). Biodiversity and nature-based solutions are mainstreamed. Spread of invasive species and zoonotic disease controlled and watersheds maintained at healthy levels.</p>
	<p>PRINCIPLE 3 <i>Minimize resource consumption and plan for circularity</i></p> <p>MAP ENERGY AND MATERIAL USE Catalog energy use, and risk indexes for major cities for appropriate investments, increase construction waste recycling and material reuse, and ensure efficient design options are considered. Consider the utilization of reusable materials for all new projects.</p>	<p>RENEWABLE MATERIAL USE Identify towns and cities with high growth potential, for green and climate smart investments minimizing consumption. Deliver zero waste construction and build with renewable materials. Invest in high-quality active travel and public transport infrastructure to help minimize emissions from vehicular transport. Implement disincentives for highly polluting vehicles.</p>	<p>CIRCULAR MATERIAL USE Apply and deliver circular economy principles to all new projects. Require projects to evaluate end-of-life options.</p>
	<p>PRINCIPLE 4 <i>Design to minimize urban heat island effect and increase natural solutions</i></p> <p>GREEN SOLUTIONS IN NEW BUILD New construction projects consider heat-reducing solutions, use of green materials, and nature-based solutions (i.e., using white roofs to reflect heat and green facades, exposed earth, and vegetation to absorb heat).</p>	<p>RETROFIT WITH NATURAL SOLUTIONS Green/natural and heat-reducing solutions are considered for new and retrofit transport infrastructure and systems (i.e., bioswales on linear infrastructure, increased greening in streets for active mobility shade/protection).</p>	<p>GREEN CORRIDORS AND HEAT REDUCTION All new transport and infrastructure to deliver heat-reducing outcomes. More than 50% of surfaces are “green.” Transport corridors help deliver increased greenery and biodiversity in the urban and rural fabric.</p>

^a International Finance Corporation Performance Standard 6.^b Mitigation Hierarchy (avoid, minimize, restore, and offset) is a tool to guide and limit negative impacts on biodiversity through the life cycle of a development project, according to CSBI.^c Achieving a net gain of biodiversity quantifies both the losses and gains of biodiversity (including offsets) through implementation of the mitigation hierarchy; demonstrates that overall gains are greater than the loss.

Case Studies



Passengers boarding the bus in Fiji (photo by Asian Development Bank 2017).

GREEN BUS NETWORK

Fiji²⁰

The government plans to replace public transport buses with a cleaner, more efficient fleet. The current fleet is obsolete and responsible for a large share of the country's GHG emissions and air pollution. The World Bank supported the government through a preliminary study that was financed by Japanese funds.



Highway from Kohalpur to Butwal, Nepal (photo by Asian Development Bank 2014).

GREEN ROAD CONCEPT

Nepal²¹

Nepal's Department of Roads has been focusing on green strategies to improve the construction standards of rural roads for years. This approach includes environmentally friendly construction techniques, a participatory and decentralized approach, optimum utilization of local resources, simple technology, and local capacity building, among others.



Eco-link bridge wildlife crossing in Singapore (photo by Jnzl on Wikimedia Commons).

ECO-LINK BRIDGE

Singapore²²

As Singapore moves toward its vision of a “city in nature,” it is now home to the first ecological bridge in Southeast Asia. The bridge was built exclusively for wildlife, to restore the ecological connection between two nature reserves divided by an expressway, allowing wildlife to expand their habitat, genetic pool, and survival chances.

²⁰ N. Rabefaniraka and A. Huerta-Goldman. 2018. When Island Buses Go Green. *World Bank Blogs*. 13 June.

²¹ R. P. Sapkota, N. Neupane, and K. Paudel. A Training Manual - Green Road Engineering. Geo Environment and Social Unit, Department of Roads. Chakupat, Lalitpur, Nepal.

²² National Parks. n.d. <https://www.nparks.gov.sg/gardens-parks-and-nature/parks-and-nature-reserves/bukit-timah-nature-reserve/ecolink-bke>

Related Trends and Principles

TABLE 18: UNDERLYING TRENDS*Climate Change*

The transport sector is one of the largest emitters of GHGs and air pollutants, and therefore has a key role to play in reaching a low-carbon and sustainable future, driven by international climate change agreements and environmental targets such as those under the Sustainable Development Goals, the Paris Agreement, and many others.

Environmental Risks

A growing number of environmental risks are impacting Asia and the Pacific. Ecological degradation is often driven by societal and economic development. Across the region we are seeing biodiversity and habitat loss, degraded ecosystems, flora and fauna extinction, and environmental pollution, all of which impact on—and are impacted by—transport systems.

Energy and Resources

Opportunity exists for the transport sector to transition to electric mobility, particularly road transport, which could significantly reduce greenhouse gas emissions and air pollution if the energy mix is mostly driven by renewable energy. The sector also has the opportunity to become more "circular" to improve the growing global waste problem.

TABLE 19: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP3: Tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability

OP4: Making cities more livable

TABLE 20: QUALITY INFRASTRUCTURE PRINCIPLES

Integrating environmental considerations in infrastructure investments

Building resilience against natural disasters and other risks



Vision 6

Robust Institutional, Financial, and Technical Capacity

Future transport will be underpinned by stakeholders, champions, and leaders able to plan, deliver, monitor, and manage transport in the long term. They will have the required governance, technical capacity, collaboration, and innovative funding and financing partnerships, as well as the supporting legislative, regulatory, and enforcement frameworks.



In 2050, the region's labor force is fully trained, skilled, and knowledgeable in the latest construction, implementation, operation, and maintenance practices. Leadership, financing, and institutional experts support the ongoing delivery of transport services.

The aim of this vision is to strengthen the knowledge, governance, capability, and adaptability of the transport sector to meet rising demands, new challenges, and innovative technologies and delivery mechanisms. This involves investing in education and training to encourage talent and strengthen the pool of professionals working in the transport sector. It also encompasses the need to build and maintain strong and efficient institutions capable of adapting to rapidly changing contexts. This entails reforming transport organizational structures to be agile and responsive to the needs of the sector as it undergoes changes over time.

In 2050, maintenance and operational plans are designed and delivered at the start of a project. Financial capacities and needs are determined from the beginning, enabling governments and institutions to operate transport networks for the future.

TABLE 21: VISION 6 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
	<p>PRINCIPLE 1 <i>Strengthen governance and build fiscal capacity</i></p> <p>SUSTAINABLE INITIATIVES Strengthening governance and institution leading initiatives can help create an affordable, yet financially sustainable transport system that is accessible by all gender and vulnerable users.</p>	<p>FISCAL SUSTAINABILITY Domestic revenues are enhanced through tax reform and reducing illicit financial flows, providing fiscal space for governments to fund their development programs.</p>	<p>FINANCIAL SUSTAINABILITY Transport visions are fulfilled in a financially sustainable manner through alternative revenue streams (i.e., using effective land value capture mechanisms and robust revenue collection).</p>
	<p>PRINCIPLE 2 <i>Build technical capacity and expertise in delivering sustainable projects</i></p> <p>SHARE BEST PRACTICES Employees participate in technically focused national and regional transport forums to share best practices in relevant transport fields depending on subregions' needs. University curriculum and technical and vocational education and training supports required knowledge and resources in the transport sector.</p>	<p>PROVIDE TRAINING INCENTIVES Incentives for upskilling are provided to interested and willing personnel to enable and empower delivery of sustainable transport infrastructure and services (i.e., operation and maintenance of high-technology operations, financial management, asset management—including operation and maintenance—post-construction).</p>	<p>RADICAL UPSKILLING Support for technological innovation with research and development funding and partnerships between universities, governments, and private sector. Countries are enabled to deliver with a skilled labor force.</p>
	<p>PRINCIPLE 3 <i>Delivering through innovative partnership and new and expanded funding</i></p> <p>EXPLORE INNOVATIVE PARTNERSHIPS Adopt institutional, policy, legal, and regulatory frameworks to enable and catalyze private sector participation and data gathering and sharing (i.e., Big Data analytics). Public sector funding is supplemented by private sector contributions (i.e., developer contributions) and investment (i.e., public-private or data partnerships).</p>	<p>DIRECT VALUE CAPTURE VIA PARTNERSHIPS Use alternative funding (i.e., over site development, direct value capture such as road pricing and congestion fees or indirect value capture), and explore innovative partnerships (i.e., partnerships with telcos to collaborate on transport data analytics projects to better integrate services, etc.) for enhanced service delivery.</p>	<p>INDIRECT VALUE CAPTURE VIA PARTNERSHIPS Extensive use of indirect value capture, offering attractive funding opportunities for the private sector while managed and regulated by government authorities.</p>
	<p>PRINCIPLE 4 <i>Strengthen legislative, regulatory, and enforcement capacity</i></p> <p>DEPLOY SUSTAINABILITY STANDARDS Appropriate legislation is in place for safety across all modes and sustainability standards are developed and deployed. Ensure clarity on functions and mandates within key government agencies and state-owned enterprises for delivering key transport services.</p>	<p>DELIVER SUSTAINABLE OUTCOMES Government agencies and state-owned enterprises are supported through policy, regulatory and institutional reform to deliver sustainable service delivery outcomes with a key focus on integrated land use and transport.</p>	<p>ADOPT TRANSPARENT STANDARDS Governments and state-owned enterprises adopt international transparency standards and corporate governance. Automated digital systems deployed for enforcement of relevant policies and legislation in the transport sector.</p>

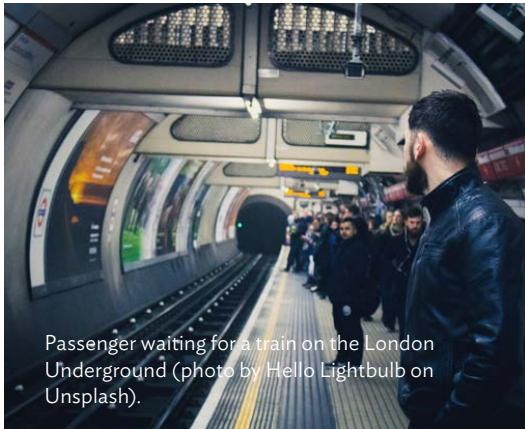
Case Studies



DIGITAL MATATUS, DIGITALLY CROWDSOURCED INFORMAL TRANSPORT ROUTES MAP

Nairobi, Kenya²³

Matatus are small private buses or minivans operated in Nairobi. Researchers from the University of Nairobi, Massachusetts Institute of Technology, and Columbia University engaged with volunteers to map Matatu bus stops and bus lines on a purpose-built smartphone. The resulting data was used to create a map, which evolved into a transit smartphone application that can be easily accessed by travelers.



TRANSPORT FOR LONDON GOVERNANCE MODEL

London, United Kingdom²⁴

The governance model under which Transport for London operates and the powers that it holds enable it to have much greater control over London's transport system compared with other UK cities. Single management of the bus system means that Transport for London can ensure quality of buses and bus services. Services and fares are specified by Transport for London and passenger revenues are kept for reinvestment in services.



THE WORLD BANK OPEN TRANSPORT PARTNERSHIP WITH RIDESHARING COMPANIES

Manila, Philippines²⁵

Ridesharing companies Easy Taxi, Grab, and Le Taxi worked with the World Bank and partners to reduce congestion issues in the Philippines by publicly sharing traffic data from their drivers' GPS streams through an open data license. This was the first scalable open-source program of its kind, allowing less-advanced economies to create more efficient real-time routing services using AI traffic management technologies.

²³ Beekmans. 2015. Mapping Nairobi's Informal Public Transport System. *Popup City*. 22 October.

²⁴ Centre for Cities. 2017. Collected Case Studies: Making the Most of Transport

²⁵ World Bank. 2016. The World Bank Launches New Open Transport Partnership to Improve Transportation through Open Data. Press release. 19 December.

Related Trends and Principles

TABLE 22: UNDERLYING TRENDS*Integrated Transport Systems*

Efficient and integrated transport systems require cross-industry planning expertise that facilitates the best use of innovative funding and investment streams (e.g., land value capture).

Adaptive Infrastructure Planning

Growing populations require adequate built infrastructure and investment to achieve sustainable growth. This requires building institutional capacity (for decisions), financial capacity (to pick up right delivery model), and technical capacity (to deliver the infrastructure).

Geopolitics and Policies

Regional and global frameworks, agreements, and wider political relationships are shaping the growth of transport across Asia and the Pacific. However, national capacities need to be enhanced, and institutions strengthened, to deliver on shared commitments.

TABLE 23: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP1: Addressing remaining poverty and reducing inequalities

OP6: Strengthening governance and institutional capacity

OP7: Regional cooperation and integration

TABLE 24: QUALITY INFRASTRUCTURE PRINCIPLES

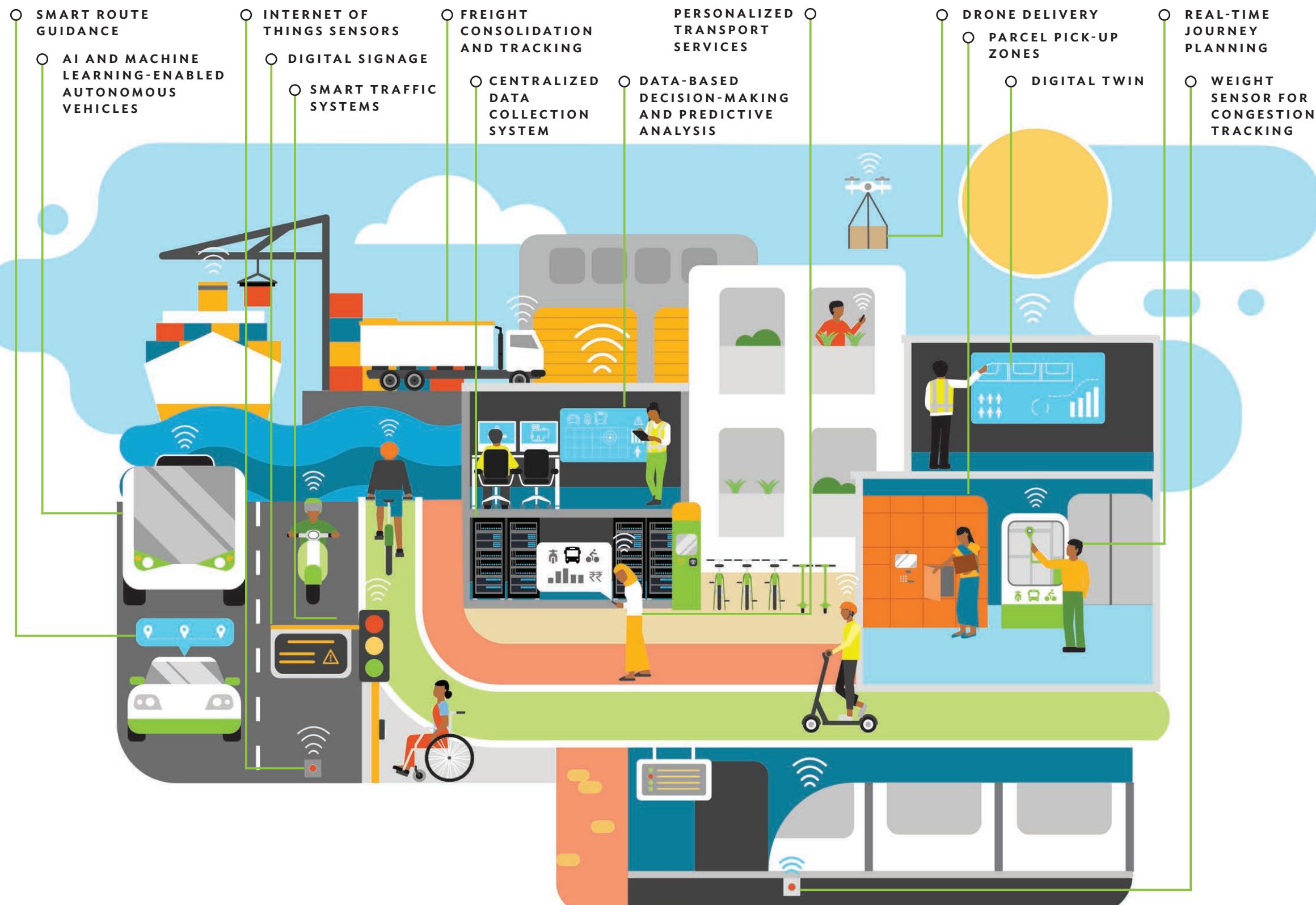
Strengthening infrastructure governance



Vision 7

Technology-Enabled Transport Services

Future transport must embrace and adopt mobility innovations that are driven by clear outcome-led planning to address specific social, environmental, and economic needs of transport users.



In 2050, transportation and technology are fully integrated, delivering seamless experiences for people and goods alike; helping maximize accessibility and connecting people to jobs, urban centers, and essential services. Systems comprise fully connected and digitally enabled networks.

By integrating data collection and analysis, the performance of transport networks is provided in real-time to users, owners, and operators. Improvements and efficiencies are found in the system by utilizing AI and machine learning to collect, analyze, and learn from data. This data is also used to map scenarios and predict possible outcomes which feed into design and construction projects and deliver more dynamic results.

This vision defines the role of technology as a tool that enables better delivery of broad policy aims and outcomes for people, transport providers, cities, and regions. Greater collaboration between the public and private sectors enables innovation that can create and deliver solutions for a variety of needs of owners, operators, and transport users.

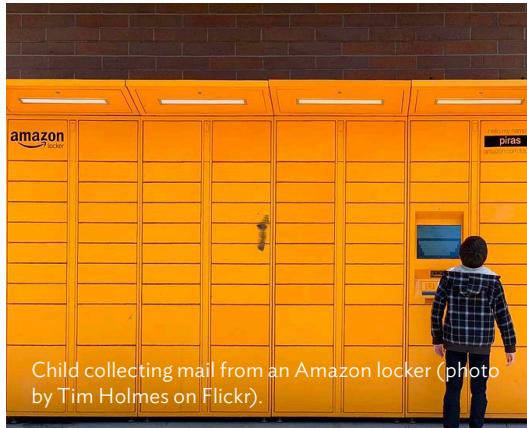
Technological solutions must be designed to deliver environmental, social, and health benefits, while promoting economic prosperity and competitiveness. Technology plays a critical role in encouraging sustainable transport choices, minimizing negative impacts, increasing comfort and convenience, and broadening connectivity to ensure equitable development.

TABLE 25: VISION 7 MATRIX

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
	<p>PRINCIPLE 1 <i>Data analytics and digital transformation</i></p> <p>DATA CAPTURE Gather data for key business, asset management, or operational processes using internet of things sensors. Apply data insights to optimize and resolve bottlenecks in transport networks and improve passenger and freight journeys.</p>	<p>DATA COLLABORATION Sharing of data analytics among users and key stakeholders to better manage assets, support decision-making, provide real-time transport journey planning, and streamline business processes for transport service providers (i.e., introducing shared portals). Smart cities concept used to enhance transport user experience and efficiency.</p>	<p>DIGITAL TRANSFORMATION Utilize simulation tools or deploy digital twins to support scenario planning for more resilient transport system operations.</p>
	<p>PRINCIPLE 2 <i>Facilitate first and last-mile connectivity for passengers and urban logistics</i></p> <p>EFFICIENT TRANSFERS More efficient point-to-point transfer thanks to freight consolidation. Increased use of lockers systems for pick-up and delivery. Personalized transport services introduced as part of wider physical and digital journeys. Ensure roads are designed to meet the needs of a variety of transport modes (i.e., walking, micro-mobility, two-three wheelers)</p>	<p>FLEXIBLE MULTIMODAL TRANSFERS Configurable and fluid transfer across transport modes through a centralized system, enabling both the mobility and delivery network to be more resilient and flexible.</p>	<p>PREDICTIVE CONNECTIVITY Transform systems at service level, technology incorporates human behavior into a system configuration of autonomous vehicles, and drones. Smartphones learn and predict rider preferences and pre-book or suggest a variety of modes for first and last-mile connectivity.</p>
	<p>PRINCIPLE 3 <i>Ensure safe and secure autonomous systems</i></p> <p>SAFE AUTONOMOUS SYSTEMS Understand the risk of data capture and sharing, privacy issues, trade-offs between security and freedom and learn about technological processes in variable environments to minimize risks and improve security (i.e., less crashes, no hacking the system) and develop data capture and storage plans.</p>	<p>AI-ENABLED SYSTEMS Utilize artificial intelligence and machine learning enabled systems to collect data, detect threats, and mitigate risk and vulnerabilities of autonomous systems.</p>	<p>OPTIMIZED FUNCTIONALITY Optimize systems to deliver repeatability and efficiencies through automation to continuously improve functionality (i.e., in control centers for route guidance, and maintenance schedules).</p>
	<p>PRINCIPLE 4 <i>Seamlessly manage and coordinate multimodal networks</i></p> <p>DYNAMIC MODAL SPLIT Journeys suggested on mobility apps that include dynamic modal split and consider time of day, congestion, and popularity to influence route choice.</p>	<p>FLEXIBLE NETWORK MANAGEMENT Responsive and flexible network and system able to manage and respond to different peak/off-peak times.</p>	<p>MODE-AGNOSTIC PAYMENT Travel-as-a-service is implemented citywide enabling transport users to choose and pay for travel by distance and time, regardless of transport mode.</p>

Case Studies



SIEMENS MOBILITY'S SAFE CAPACITY TRAIN

WEIGHT SENSORS

*London, United Kingdom*²⁶

Govia Thameslink Railway can sense and limit how many people are aboard its trains by using weight-monitoring sensors from Siemens Mobility. Introduced in response to COVID-19 to monitor traveler proximity and crowd density, the technology is also applicable to capacity-monitoring, informing rail authorities of changes in passenger flow and likelihood of overcrowding.

AMAZON LOCKER SYSTEM

*Global*²⁷

Lockers are self-service kiosks where customers can collect or return their Amazon parcels at a time that's convenient for them. Counters are retail locations such as convenience or high street stores where customers can pick up their Amazon parcels—the parcel will be handed over by a staff member in store.

MOBILEYE'S TECHNOLOGY FOR MACHINE LEARNING-ENABLED VEHICLES

San Jose, United States^{28,29}

Mobileye provides advanced driver systems technology (machine vision and deep learning) to car companies. Their systems perform functions such as identifying speed limits, oncoming obstructions and automatic breaking—based on data collection and recognition. As a car drives, images such as road signs are captured and annotated. These are added to a neural network and used to recognize real-world objects.

²⁶ G. Paton. 2020. Weight Sensors Help Keep Trains At "Safe" Capacity. *The Times*. 30 May.

²⁷ Amazon. Amazon Hub.

²⁸ MobileEye. An Intel Company.

²⁹ T. Cohen, A. Rabinovitch, and P. Leinert. 2017. Intel's \$15 Billion Purchase of Mobileye Shakes Up Driverless Car Sector. *Reuters*. 13 March.

Related Trends and Principles

TABLE 26: UNDERLYING TRENDS*Behavior Patterns*

New digital lifestyles influence users' behavior regarding transport modes and choices, and it is crucial that regulation (e.g., around data collection from new mobility providers or physical safety) keeps up with innovation and ensures safety of users.

Integrated Transport Systems

Modal share is influenced by the increasing availability of new mobility concepts such as shared mobility and ride-hailing apps.

Advanced Technologies

Advanced digital technologies including autonomous systems, AI, and machine learning or internet of things are transforming how transport systems are managed and used. When deployed with a user and outcome-led focus, there is vast potential to improve future journeys across all modes.

TABLE 27: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP1:Addressing remaining poverty and reducing inequalities

TABLE 28: QUALITY INFRASTRUCTURE PRINCIPLES

Maximizing the positive impact of infrastructure to achieve sustainable growth and development

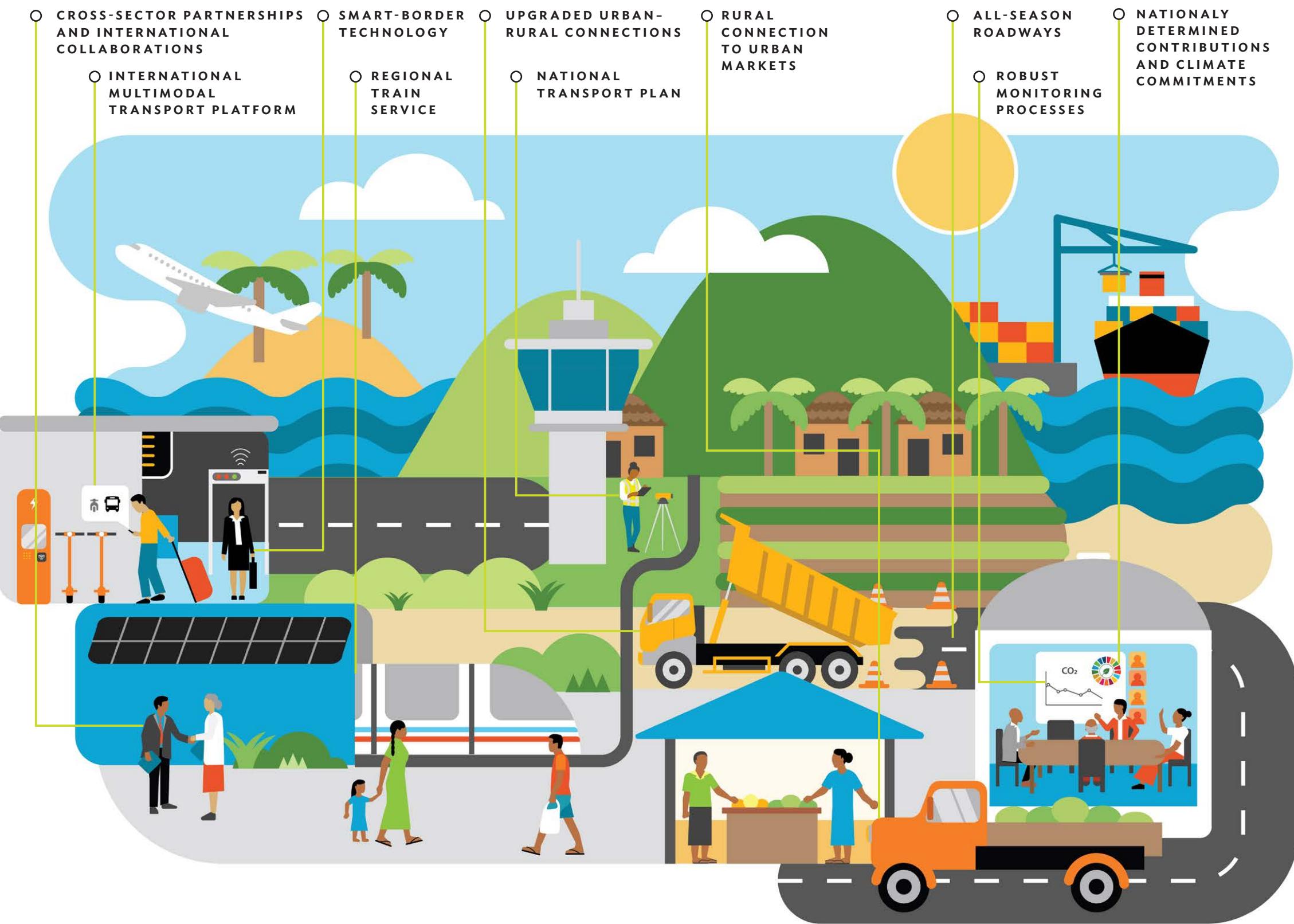
Building resilience against natural disasters and other risks



Vision 8

Strong Regional Cooperation and Comprehensive Development

Future transport infrastructure and systems will provide crucial support for regional cooperation and collaboration to deliver multimodal strategic transport connectivity. This will facilitate critical economic corridors to deliver big picture development benefits across Asia and the Pacific.



2050 finds cities and countries connected through shared and co-developed systems. Broad collaboration and cooperation toward global goals and frameworks unifies transport throughout the region.

In 2050, the region's transport systems are seamlessly connected to enable regional environmental and development goals. This ensures citizens have consistent and reliable transport experiences, information, services, and expectations as they travel across borders. This encourages the exchange of ideas, regional cohesiveness, and shared economic benefits.

Cross-regional cooperation also ensures the transport needs of people and different countries across the region are considered.

A central entity oversees and coordinates actions to plan, fund, and deliver cross-countries' transport infrastructures. This ensures adequate monitoring and responsive maintenance of assets as well as providing the right platform to tackle cross-boundary shared challenges, including how best to decarbonize transport while meeting increased demand for mobility. Driving electrification, clean grid, and increased uptake of renewable energy will require international as well as cross-sector collaboration.

TABLE 29: VISION 8

Principles and Strategies to 2030

SCENARIOS	STRATEGY: BASELINE	STRATEGY: PROGRESSIVE	STRATEGY: TRANSFORMATIVE
 PRINCIPLE 1 <i>Integrate urban and rural transport</i>	DELIVER NATIONAL TRANSPORT PLANS National transport plans that address issues of rural–urban (or interisland) connectivity, rapid urbanization, and rural–urban migration (or migration from outer islands) in some countries due to climate change are developed and implemented by both national transport agencies and local authorities.	ALL-SEASON TRANSPORT CORRIDORS New construction projects boost job creation in the wider economy. Improved all-season roadways, railways, and other pathways to transport rural goods to urban market supporting rural growth. Improved monitoring and maintenance means transport infrastructure is better coordinated and delivered.	FULLY CONNECTED NETWORKS All rural areas (or outer-island communities) are connected to major cities through all season roadways (or interisland maritime or air-connectivity) and shared networks that are affordable, efficient, and safe. Low-carbon transport creates economic transformation in previously isolated areas.
 PRINCIPLE 2 <i>Share a commitment to global frameworks</i>	REGIONAL KNOWLEDGE SHARING Utilize regional cooperation frameworks and forums to synergize implementation of global commitments (i.e., Sustainable Development Goals, Paris Agreement, Sendai Framework on Disaster Risk Reduction, and Stockholm Declaration on Road Safety, etc.). Facilitate regional knowledge sharing to ensure knowledge transfer to enhance implementation.	REGIONAL COLLABORATION Co-develop regional transport strategies and action plans to enhance integration between transport modes and across sectors, ensuring strong alignment with global frameworks (i.e., Paris Agreement, UNSDGs, Sendai Framework and Stockholm Declaration on Road Safety, etc.). Enhance financing in regional and global initiatives to promote sustainable transport.	ENHANCED REGIONAL AMBITION Scale up ambition and action on global agendas by establishing and implementing regional targets and joint action plans (i.e., global road safety targets, net-zero emissions, climate adaptation, disaster risk reduction and sustainability for transport and other sectors, etc.).
 PRINCIPLE 3 <i>Expand regional and cross-border connectivity</i>	COORDINATED COMMITMENTS Coordinated commitment between national, regional, and global transport initiatives, systems, and networks. Plan to facilitate cross-border movement of people and goods and to anticipate domestic migration from rural (or outer-island) to urban areas.	COORDINATED IMPLEMENTATION Advanced technologies are deployed to deliver efficient movement of people and goods that are transported between different regions (i.e., smartphone-enabled applications that map different country transport systems).	CROSS-COUNTRY INTEGRATION Transportation systems are fully integrated and multimodal throughout the region and between countries.
 PRINCIPLE 4 <i>Facilitate cross-sector collaboration</i>	CROSS-SECTOR PLANNING Development of holistic and cross-sector infrastructure plans at a citywide, national, and regional level (i.e., integrating multipurpose infrastructure that has co-benefits with energy, climate change, environment, etc.).	CROSS-SECTOR COORDINATION Coordination mechanisms are frequently used and produce clear outputs and outcomes, new infrastructure considers connected systems at the start of design.	DESIGN FOR SYSTEMS INTEGRATION New and retrofit transport and infrastructure projects consider and design for systems integration, delivering better outcomes for society, economy, and the environment.

Case Studies



PROJECT LOGICAL: TRANSNATIONAL LOGISTICS' CLOUD COMPUTING TOOL

Across Europe³⁰

Project LOGICAL further develops the "InterLogGrid" research project, funded by the German Ministry for Education and Research. It developed a transnational logistics cloud computing tool which virtually connects logistics hubs, allowing smaller companies to collaborate with global players and improve "interoperability," as well as improving the competitiveness of Europe's logistics hubs.



MEERUT REGIONAL RAPID TRANSPORT SYSTEM

Delhi, India³¹

The ADB investment will support construction of the 82 km high-speed Delhi–Meerut Regional Rapid Transit System, a first of its kind in India. The transit system aims to help decongest Delhi and improve regional connectivity by connecting Delhi to Meerut in the state of Uttar Pradesh. The project is expected to save 258,035 tons of GHG annually and improve mobility and economic opportunities for women and vulnerable users.



ENHANCED "TRUCK-RAIL-TRUCK" CROSS-BORDER FREIGHT SERVICES

People's Republic of China—Viet Nam border³²

A new "Truck-Rail-Truck" service from CEVA Logistics has improved freight movement between the People's Republic of China and Southeast Asia by reducing clearance times at customs. Shipments are collected by truck in the People's Republic of China, loaded into containers and transported to Viet Nam on daily cross-border trains, then transferred back onto trucks for distribution across Southeast Asia.

³⁰ Transport Research and Innovation Monitoring and Information System. 2014. Transnational Logistics' Improvement through Cloud Computing And Innovative Cooperative Business Models. European Commission. <https://trimis.ec.europa.eu/project/transnational-logistics-improvement-through-cloud-computing-and-innovative-cooperative> (accessed 23 April 2021).

³¹ ADB. 2020. *India: Delhi-Meerut Regional Rapid Transit System Investment Project*. Manila.

³² Railways Gazette. 2020. Rail and Road Services to Avoid Border Delays in South East Asia. 28 May.

Related Trends and Principles

TABLE 30: UNDERLYING TRENDS*Climate Change*

Implementing ambitious global transport sector commitments, such as climate change, will require strong regional cooperation to reduce GHG emissions and adapt to a changing climate while ensuring equity for developing nations.

Economic and Trade Patterns

Asia and the Pacific's strong trade (i.e., cross-regional cooperation) and financial integration is both integral to the region's success and an indicator of it.

Geopolitics and Policies

The work of ADB, other multilateral development banks, bilateral donor agencies, and others is accelerating regional connectivity.

TABLE 31: ADB STRATEGY 2030 OPERATIONAL PRIORITIES

OP6: Strengthening governance and institutional capacity

OP7: Regional cooperation and integration

TABLE 32: QUALITY INFRASTRUCTURE PRINCIPLES

Maximizing the positive impact of infrastructure to achieve sustainable growth and development

Strengthening infrastructure governance

Conclusion

In the coming years, transport will be critical in the economic and social development of countries across Asia and the Pacific. Transport infrastructure is a key driver for development and a tool to stimulate positive economic and social outcomes.

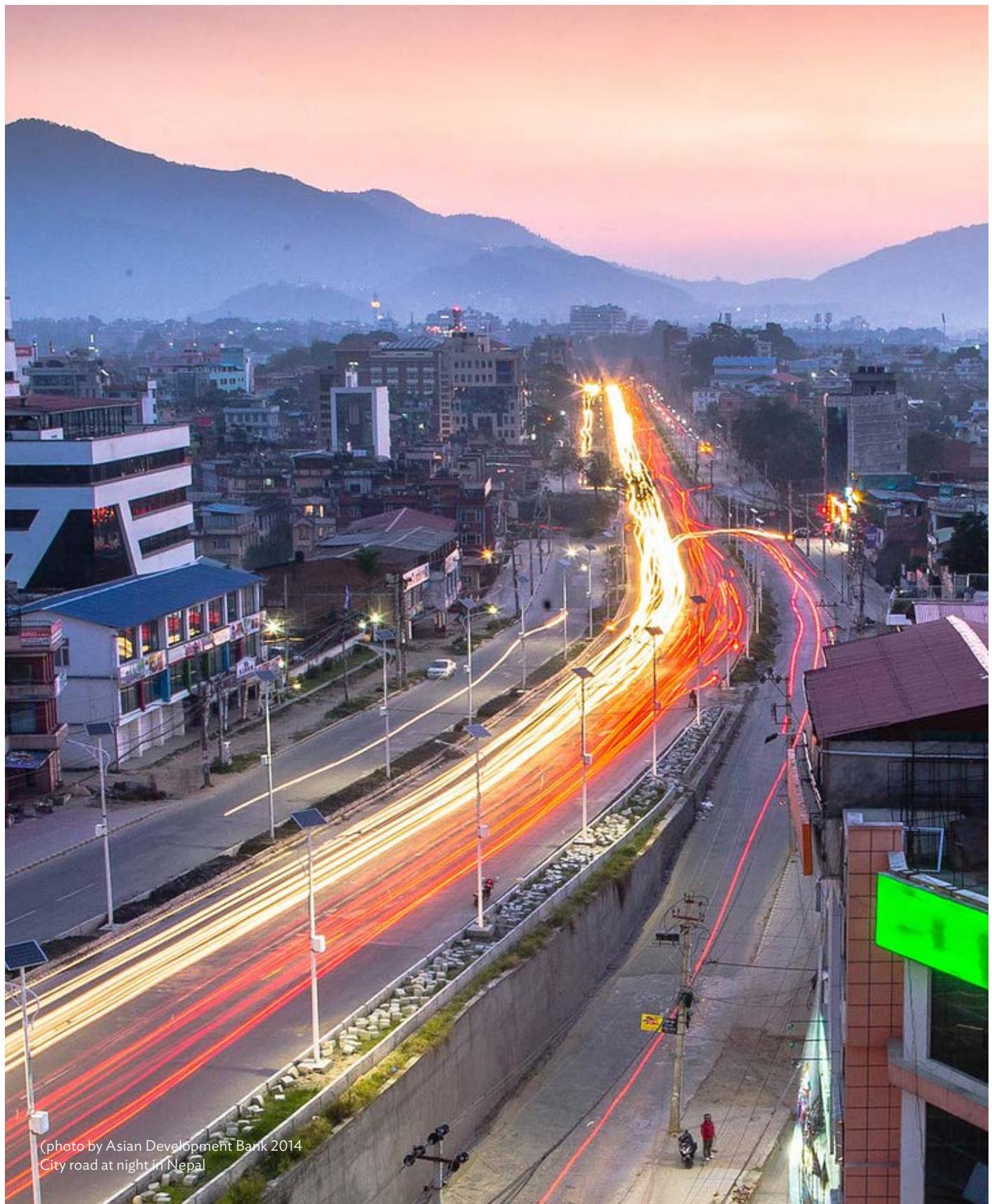
As we recover from the pandemic, it is urgent to get things right and to “build back better.” Ensuring that new transport investments are resilient and future-ready, while delivering a broad range of socioeconomic and environmental outcomes, will contribute toward this goal. A new rail project can be about much more than an increase in capacity. If we consider wider benefits across factors such as gender, resilience, market access, or habitat restoration, its effects can be far greater.

By looking “beyond the obvious” we can try to understand all the opportunities and risks associated with a project and identify new areas for innovation. Getting this right requires a holistic and forward-thinking approach. This is where foresight helps. A holistic view of the future can be particularly useful at the pre-concept stage of both new transport projects and network upgrades.

By analyzing a wider range of possible trends shaping a country strategy, transport sector strategy, or even stand-alone projects over the coming decades, stakeholders have a starting point to think about what the project is hoping to achieve, how we can rethink its delivery, and what we can do to minimize the risks and maximize the opportunities that future trends may introduce. It is often the non-obvious factors and those outside of our own area of expertise that can unlock the most interesting solutions.

A key requirement for the successful understanding, integration, and deployment of foresight work is institutional capacity. This is perhaps the single most important lever toward making change happen. It is one thing to be aware of trends. But being able to anticipate and better respond to them is another matter entirely. We need to expand the futures literacy and foresight capabilities of any organization that plans for and designs transport systems.

We hope this document will provide a launchpad and inspiration for dialogues about the future of transport within ADB internally, as well as clients and partners across the region. By taking futures thinking into consideration and deploying foresight approaches, transport projects can go beyond simply moving people and goods from point A to point B, but become a catalyst for much deeper, sustainable, and positive change.



(photo by Asian Development Bank 2014
City road at night in Nepal)

Operational Principles

ADB'S STRATEGY 2030

ADB's long-term corporate strategy for the next decade (Strategy 2030) sets the course for the bank's efforts to respond effectively to the region's changing needs. Under this strategy, ADB will expand its vision to achieve a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. This will be delivered through combination of finance, knowledge, and partnerships to fulfill its expanded vision. The key operational priorities underpinning this strategy are as follows:



1. Addressing Remaining Poverty and Reducing Inequalities

This will be delivered through increasing the emphasis on human development and social inclusion, generating quality jobs, improving education and training, achieving better health for all, and ensuring social protection for those in need.



2. Accelerating Progress in Gender Equality

This will be delivered through scaling up support for gender equality, promoting women's economic empowerment, pursuing gender equality in human development, enhancing gender equality in decision-making and leadership, reducing "time poverty" of women, and strengthening women's resilience to external shocks.



3. Tackling Climate Change, Building Climate and Disaster Resilience, and Enhancing Environmental Sustainability

This will be delivered through scaling up support to address climate change, disaster

risks, and environmental degradation, accelerating low greenhouse gas emissions development, ensuring a comprehensive approach to build climate and disaster resilience, ensuring environmental sustainability, and increasing focus on the water–food–energy security nexus.



4. Making Cities More Livable

This will be delivered through providing integrated solutions, supporting funding for cities, enhancing inclusive and participatory urban planning, increasing climate resilience, and disaster management.



5. Promoting Rural Development and Food Security

This will be delivered through improving market connectivity and agricultural value chain linkages, increasing agricultural productivity and food security, and enhancing food safety.



6. Strengthening Governance and Institutional Capacity

This will be delivered through supporting public management reforms and financial stability, strengthening service delivery, and strengthening capacity and standards.



7. Fostering Regional Cooperation and Integration

This will be delivered through enhancing connectivity and competitiveness, promoting regional public goods, strengthening cooperation in the financial sector, and strengthening subregional initiatives.

QUALITY INFRASTRUCTURE INVESTMENT PRINCIPLES

In June 2019, G20 Finance Ministers endorsed the call for quality infrastructure through the endorsement of the Principles for Quality Infrastructure Investment (QII) at the G20 Finance Ministers' and Central Bank Governors' Meeting in Fukuoka, Japan.

The key drivers for operationalizing these principles are efficiency, accessibility, and sustainability:

- *Efficiency*
requires project selection that achieves the most social and economic benefits per dollar invested. Value for money assessment, for example, measures social, environmental, and economic benefits in a public-private partnership versus a traditional investment.
- *Accessibility*
is based on greater inclusiveness and responsiveness to increasing inequalities, and involves elements of last-mile outreach.
- *Sustainability*
is based on extending the life of an infrastructure asset and creating infrastructure projects that are resilient and adaptive to the effects of climate change. It considers fiscal, economic, environmental, social, technology, and governance issues; is consistent with the 2030 Agenda for Sustainable Development and the Paris Agreement to reduce GHGs; and aligns with countries' national and local development strategies.

The principles are as follows:

1. Maximizing the positive impact of infrastructure to achieve sustainable growth and development
2. Raising Economic Efficiency in View of Life-Cycle Cost
3. Integrating Environmental Considerations in Infrastructure Investments
4. Building Resilience against Natural Disasters and Other Risks
5. Integrating Social Considerations in Infrastructure Investment
6. Strengthening Infrastructure Governance

Reimagining the Future of Transport Across Asia and the Pacific

The world is rapidly changing. Urbanization, shifting demographics, climate change, access to data, and the coronavirus disease (COVID-19) pandemic are increasingly impacting how we live, work, and travel. This study identifies key trends that will shape the future of transport, as well as their associated opportunities, risks, and uncertainties. Drawing from these insights, a set of visions, principles, and strategies have been developed to spark reimagining on the types of transportation systems, networks and infrastructure that would be needed for the future. These are intended to stimulate discussion and inspire new pathways and approaches for future investments, planning and transport policy, particularly within the Asia and the Pacific, with a view to 2030 and 2050. Complementing the main report is a set of trend cards that delves into key aspects and drivers of change underlying the emerging trends, as well as a playbook on how to apply foresight approaches for strategy, policy, and project planning.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 68 members—49 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

About Arup

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. Working in more than 140 countries, the firm's designers, engineers, architects, planners, consultants, and technical specialists work with our clients on innovative projects of the highest quality and impact. www.arup.com



ASIAN DEVELOPMENT BANK

6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
www.adb.org