Summary for PolicyMakers

SUSTAINABLE URBAN INFRASTRUCTURE TRANSITIONS IN THE ASEAN REGION: A RESOURCE PERSPECTIVE

In collaboration with:

International Resource Panel

Design and layout: Anna Mortreux
Printed by: UNESCO
Photos: ©AsiaTravel/Shutterstock, ©Sean Hsu/Shutterstock, ©Phuong D. Nguyen/Shutterstock, ©Sacha Fernandez, ©zany-jadraque

Disclaimer

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the United Nations Environment Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning delimitation of its frontiers or boundaries. Moreover, the views expressed do not necessarily represent the decision or the stated policy of the United Nations Environment Programme, nor does citing of trade names or commercial processes constitute endorsement.

The full report should be cited as: UN Environment (2018). *Sustainable Urban Infrastructure Transitions in the ASEAN Region: a Resource Perspective.* United Nations Environment Programme, Nairobi.

DTI/2167/PA
UNEP 190

Summary for PolicyMakers

Sustainable Urban Infrastructure Transitions in the ASEAN Region: A Resource Perspective

Acknowledgements

Authors: Anu Ramaswami, Samuel Tabory, Ashly McFarlane and Rylie Pelton.

Editorial Supervision and coordination: UN Environment, Economy Division in collaboration of the International Resource Panel with special thanks to Martina Otto, Peder Jensen, Sharon Gil, Ainhoa Carpintero and André Confiado who provided content input, conceptual direction and reviewed the document at various stages of the report

We are very grateful to the support provided by the China-ASEAN Environmental Cooperation Centre (CAEC) and the League of Cities of the Philippines, specially Peng Ning and Ma. Veronica C. Hitosis.

Peer review: This report went through a peer review process coordinated by Peng Ning with the support of UN Environment. We are very grateful to the peer review coordinator and to the reviewers who provided valuable comments to the report: Timothy Baynes (Commonwealth Scientific and Industrial Research Organisation); Virgil B. Bilaro (Bicol University); Felicity Cain (UNESCAP); Jason Cao (University of Minnesota); Lei Fang (Industrial Bank of China); Shi Han (City University of Hong Kong); Ma. Veronica C. Hitosis (League of Cities of the Philippines); Oscarlito C. Malvar (UNIDO); Esteban Muñoz (UN Environment); Abhishek Pandey (All India Institute of Local Self-Government); Shi Lei (Tsinghua University); Naylin Oo (UNESCAP); Remy Sietchiping (UN-Habitat); Marco Silvestri (UNESCAP); Jiang Yang (China Sustainable Transportation Center); Zhang Chun (Beijing Jiaotong University).

We wish to thank all the participants of the two workshops organized under this project and held on 15-17 March, 2017, Beijing, China and 24-25 July 2017, Manila, Philippines.

Foreword

Infrastructure investments made today will impact the structure of cities and determine the quality of life of their citizens for at least the next 30 years. A city, for example, can choose to build more roads for privately owned vehicles or invest in public transport, and the decision will determine how people move about, get to work and school, and socialize. The same decisions also influence the environment. The more compact and connected a city, the easier it is to implement public and non-motorized transport. More broadly, density leads to efficient use of resources and allow for green spaces that serve as carbon sinks, purify air, and help manage water.

This report comes at an important time for the ASEAN, when many decisions about infrastructure investments are being made. Southeast Asia has one of the fastest growing rates of urbanization in the world, and expects over 200 million more urban residents to be added to the 300 million current residents by the year 2050. This growth will increase the demand for basic services in places where many are already underserved. This is a challenge for leaders in ASEAN countries but it also creates a historic opportunity to plan and build infrastructure that lays the foundation for sustainable urbanization in the ASEAN region.

Leaders in ASEAN member countries have shown commitment to sustainable development. UN Environment is, in turn, committed to supporting ASEAN members at all levels in their efforts to achieve responsible growth and development. This report is one of our contributions.

Drawing from the conclusions in the forthcoming global report of the International Resource Panel "*The Weight of Cities: Resource Requirements of Future Urbanization*" this regional report aims to support policy makers by delving into the specifics of the ASEAN member countries – their dense cities, economic growth characteristics, susceptibility to climate change impacts, high informality, relative political stability, and other characteristics – and shows a way forward that speaks to the opportunities and obstacles faced by regional leaders.

The report also links ASEAN concerns to global processes, such as the Sustainable Development Goals, Paris Agreement, and the New Urban Agenda. It stresses the importance of linking global, regional, national, and local action, recognizing the role of various levels of governance in ensuring sustainable urbanization. The bottom line is that building sustainable cities is not the job of local government alone.

We hope that this report will enhance links across all levels of governance and provide ideas to ASEAN leaders on fostering urban sustainability. We also hope that the lessons from the region contained in this report will resonate with others around the world as we work towards building low-carbon, resilient, and resource efficient cities.

Ligia Noronha
Director, Economy Division
UN Environment

© Bambi Corro/Shutterstock

A. Population megatrends and the imperative for urban infrastructure transformation in the ASEAN region

The ASEAN nations are a hot spot for rapid urbanization over the next 30 years: Between 2015 and 2050, ASEAN cities are projected to add 205 million new urban residents to the 300 million current urbanites in the region, creating one of the world's largest middle-income emerging markets after China and India. The region's urbanized population proportion will increase from 47 per cent in 2014 to 65 per cent in 2050, with five of the ten ASEAN nations transitioning from minority urban to majority urban. This represents a significant demographic shift that will change the way people live and the way human settlements are designed and function. Simultaneously, the ASEAN region will continue to grow as an economic powerhouse, projected to become the fourth largest economy in the world by 2050 (HV, Thompson, and Tonby, 2014) and experiencing one of the largest rises in the urban middle class.

The region's new urban population growth is expected to result in the unprecedented and rapid rise of more than 200 smaller cities in just 35 years (2015-2050), in addition to continued growth in existing medium and large cities. The UN Department of Economic and Social Affairs estimates that fully half of future urban population growth in the ASEAN through 2030 will occur in cities with fewer than 500,000 residents. Extrapolating to 2050, this means that the ASEAN region can expect the rise of more than 200 small cities over the relatively short period of some 35 years (2015 to 2050). The region will have to plan in a concerted manner to accommodate such a large number of cities, and will need to rethink urban infrastructure planning for a diversity of city sizes (small, medium and large).

Figure 1 • TOTAL PROJECTED URBAN POPULATION IN 2050 *(UNDESA Population Division, 2014)*.
ASEAN urbanization is projected to be one of the largest after China and India, particularly in the context of urban middle class expansion.

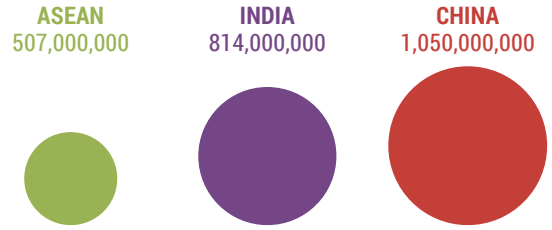


Figure 2 • ABSOLUTE URBAN POPULATION GROWTH (ESTIMATED DIFFERENCE 2030 – 2015 URBAN POPULATIONS) PROJECTED TO OCCUR IN SMALL (<0.5 MILLION RESIDENTS) AND MEDIUM/LARGE CITIES (>0.5 MILLION RESIDENTS) *(UNDESA Population Division, 2014)*

Figure 3 • PERCENTAGE OF URBAN GROWTH (2015-2030) PROJECTED TO OCCUR IN SMALL CITIES (<0.5 MILLION RESIDENTS) AND MEDIUM/LARGE CITIES (>0.5 MILLION RESIDENTS) *(UNDESA, Population Division 2014)*

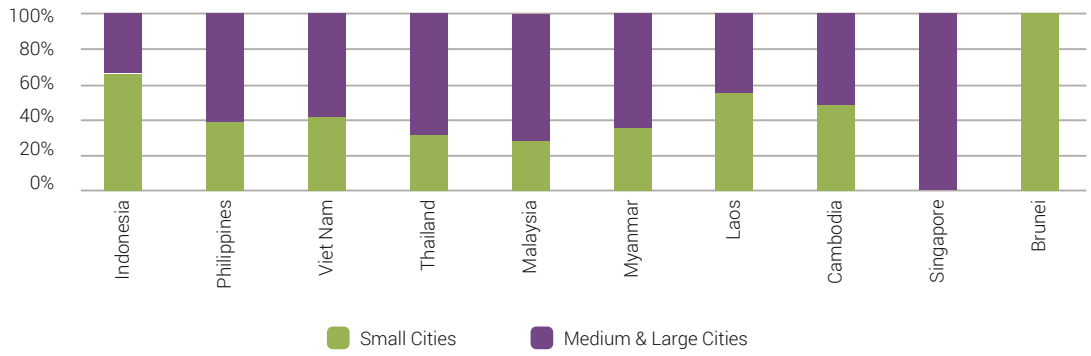
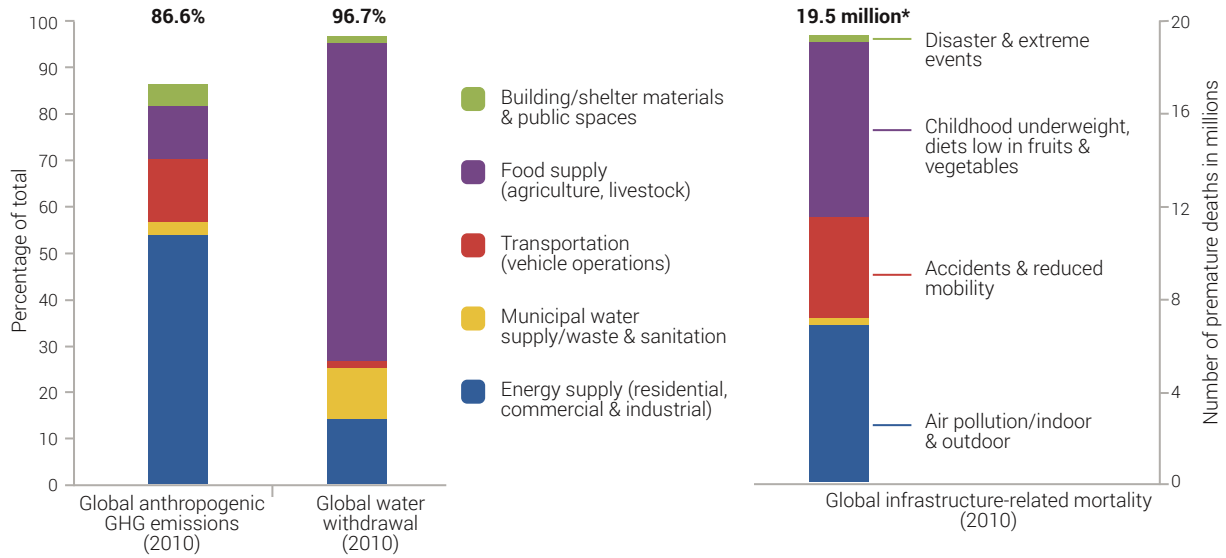


Table 1 • EXAMPLES OF FAST GROWING CITIES IN THE ASEAN REGION 2015-2030 *(UNDESA Population Division, 2014)*

Country	City	Absolute Percentage Growth 2015-2030	Annual Percentage Growth Rate 2015-2030
Laos	Vientiane	78.8	5.3
Indonesia	Batam	78.8	5.3
Thailand	Samut Prakan	73.1	4.9
Indonesia	Denpasar	69.0	4.6
Indonesia	Tasikmalaya	65.8	4.3
Vietnam	Can Tho	61.9	4.1

UNDESA Population Division data used for calculating these growth rates drawn from a universe of urban agglomerations of 300,000 or more across the ASEAN region. There may be smaller cities that are expected to grow at even faster rates.

Figure 3 • GHG EMISSIONS, WATER WITHDRAWALS AND HUMAN HEALTH IMPACTS OF KEY INFRASTRUCTURE AND FOOD SUPPLY SECTORS *(Ramaswami et al., 2016)*



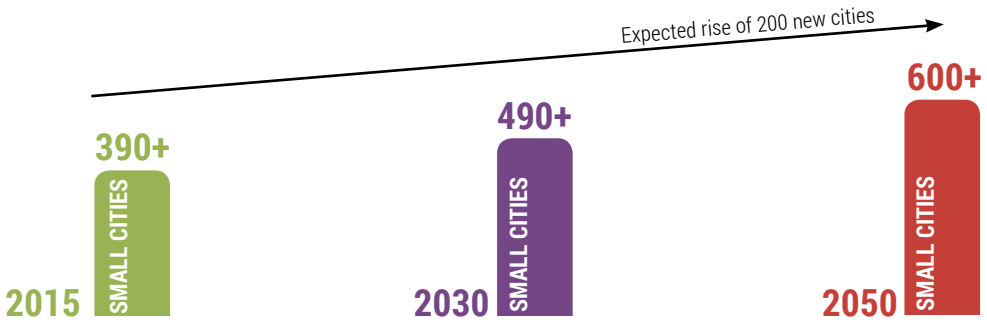
Urban population growth is likely to be very rapid in many ASEAN countries between 2014 and 2050. **This means that new urban infrastructure is needed urgently and rapidly.** The average expected urban population growth rate for the ASEAN region is 2.2 per cent per annum, with some countries such as Cambodia and Laos exceeding 4 per cent per annum. Population growth rates in individual cities can be even faster, exceeding 5 per cent per annum (see Table 1). A city with a 5 per cent annual growth rate can expect its population to double roughly every 15 years. This means that new urban infrastructure is needed urgently and rapidly. Estimates suggest that the ASEAN region will require some seven trillion dollars (US) in new urban infrastructure and housing investment through 2035 (Lin, 2015). Once built, infrastructure such as buildings, water treatment systems, transportation systems and power plants have decades-long life spans, often exceeding 30 years or more. **There is a once-in-a-lifetime strategic opportunity for the ASEAN region to plan ahead for building sustainable, resource-efficient, and inclusive infrastructures for future cities.**

Seven key infrastructure sectors that provide buildings/shelter, public spaces, food supply, transportation, municipal water supply, waste and sanitation, and energy supply dominate both natural resource use and resulting impact on the environment and human well-being (see figure 3). These sectors, together referred to as basic infrastructure and food supply sectors, directly impact economic activity, livelihoods, access, inclusion, pollution and well-being in cities. These sectors also contribute to 80 per cent of global material use, more than 90 per cent of water withdrawals, and about 87 per cent of global greenhouse gas (GHG) emissions, impacting resource sustainability globally. Recent reports from UN Environment indicate that early action toward resource-efficient and inclusive development of these key infrastructure sectors in cities can yield multiple sustainability benefits (International Resource Panel, 2017).

The above megatrends in the ASEAN region have critical policy implications.

- First, as the ASEAN region urbanizes**, policy-makers must plan ahead for resource-efficient and inclusive urban infrastructure development that can yield multiple SDG co-benefits.**
- **Second, the ASEAN region must think strategically about urban infrastructure across a range of diverse city sizes**: small, medium and large, across the ten nations, with particular attention to the rise of 200+ smaller cities.
- **Third, early and anticipatory infrastructure planning efforts at multiple levels of government – the cross-ASEAN, national, and city-regional levels – are needed** to guide the sustainable development of these rapidly growing and urbanizing areas from the outset to address many of the urbanization challenges already being seen in the region.
- **Fourth, the ASEAN region has the advantage of being able to leverage a strong and growing economy to support land-based value capture tools for financing critical urban infrastructure investments.** The region's GDP is expected to triple between 2013 and 2040 Organization for Economic Cooperation and Development/International Energy Agency (OECD/IEA), (2015). Increasing urban land values, driven by growing wealth and urbanization, present a strategic and timely opportunity to finance future sustainable urban infrastructure transitions.

Figure 4 • SMALL CITIES ACROSS THE ASEAN REGION IN 2015, 2030, AND 2050
(based on data from UNDESA Population Division 2014)



Calculations based on city population size of 500,000 or less; 2050 estimate extrapolated from small city growth trends from 2015-2030.

© Joyfull/Shutterstock

B. The risk of inaction – infrastructure challenges of urbanization with current practices

If the ASEAN region's projected rapid urbanization proceeds according to current business-as-usual practices, ASEAN cities will see existing urban challenges exacerbated and the emergence of potentially new challenges such as those already seen in fast-growing cities in China and India.

CURRENT AND FUTURE ASEAN URBANIZATION CHALLENGES

Urban expansion onto surrounding high-value agricultural and ecologically-sensitive hinterlands. By 2030, urban land expansion in the ASEAN region is expected to have large-scale impacts on the surrounding countryside. Losses of some 2 per cent of total crop production in Indonesia and 16 per cent in Viet Nam are anticipated due to agricultural land lost to urban expansion (d'Amour et.al. 2017). In the Philippines, more than 4 per cent of biodiversity hot spots are at risk from urban expansion (Seto et.al. 2012).

Unplanned, haphazard, and insufficient infrastructure provisioning. Rapid population growth in ASEAN cities makes infrastructure deficits a challenge. Region-wide, an estimated 73 million urban residents lived in slum developments in 2014. That number could grow if rapid growth is not met with adequate infrastructure planning. Unplanned growth increases inequality – creating slums on one hand and self-segregated wealthy enclaves and townships on the other.

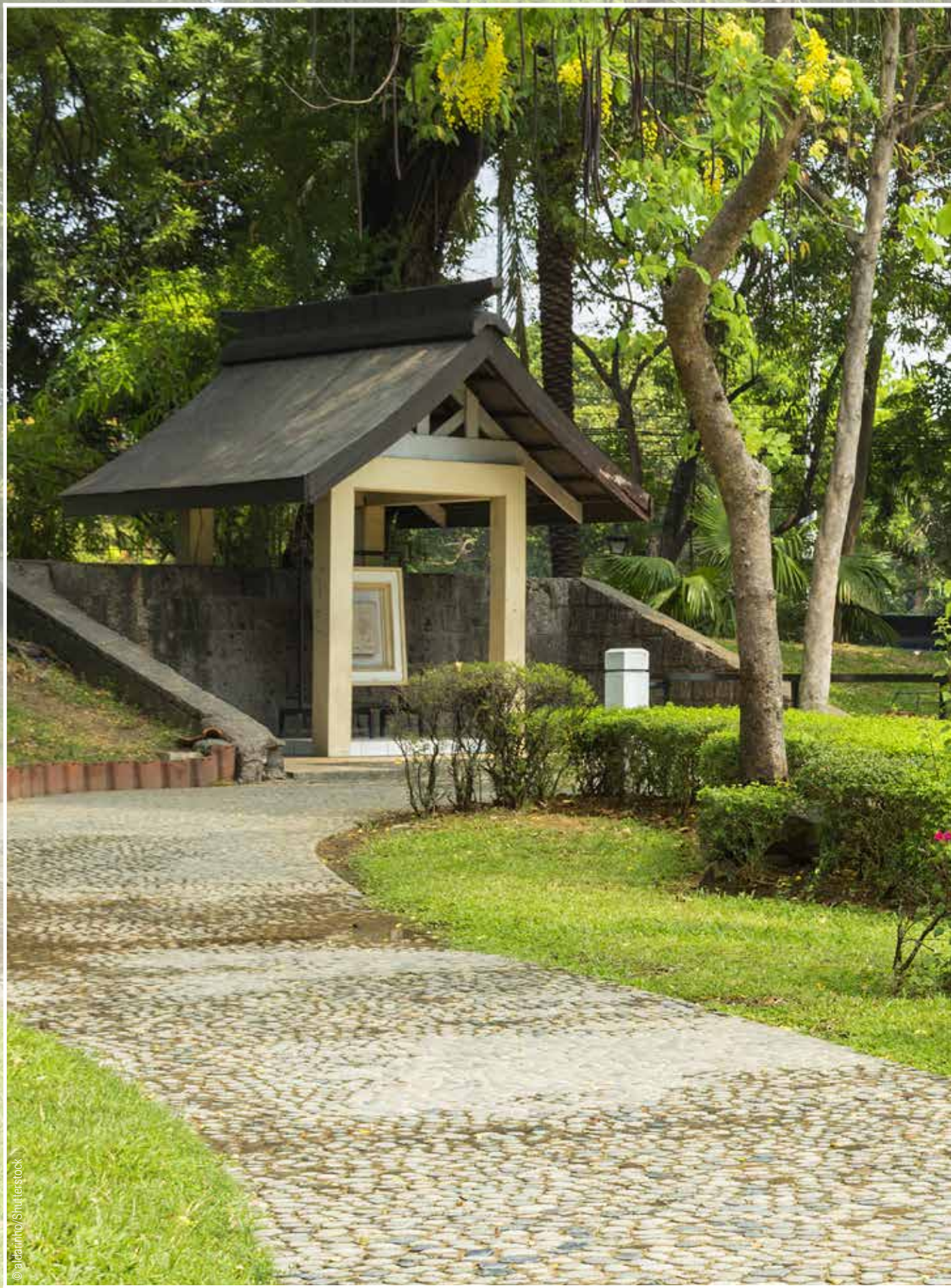
Concentrated use of polluting fossil fuels for industry and transportation in populous cities, resulting in high levels of air pollution and premature mortality. Air pollution is a principal cause of chronic respiratory disease, which caused more than 225,000 deaths region-wide in 2016 (Institute for Health Metrics and Evaluation (IHME), 2016). Without reducing motorized travel and fossil fuel use in cities, urbanization in the ASEAN region could produce dangerous levels of air pollution similar to those seen in several cities in India and China with average annual PM2.5 concentrations exceeding 100 ug/m^3. Today, most ASEAN cities report PM2.5 levels above those that the WHO considers safe (<10 ug/m^3), thus continued reliance on fossil fuels is expected to exacerbate air pollution (World Health Organization (WHO), 2016a).

Increased reliance on coal as the region's demand for energy rises. The region's total primary energy demand is projected to rise by 80 per cent through 2040 over 2013 levels, during which time the region's economy is expected to more than triple. Amid this growth, the share of coal in the region's electricity supply mix will rise from 32 per cent to 50 per cent by 2040. Coal demand is projected to triple to become the largest fuel source of the region's primary energy demand followed closely by oil (OECD/IEA, 2015), raising both the potential for increased air pollution and global carbon emissions.

Poor urban waste management controls increasing air, land, freshwater, and marine pollution. Infrastructure to minimize solid waste generation and better manage waste is critical in dense urban areas. Waste burning in cities contributes to air pollution, and untreated sewage threatens marine pollution and disease outbreaks. Across the ASEAN region, rates of urban residents with access to improved sanitation facilities vary widely, with highs of 95 per cent or more in Singapore and Laos, and with lows of 78 per cent or less in the Philippines and Indonesia (World Bank, 2015).

Reduced resilience to natural disasters. The ASEAN region is at high risk of climate-related hurricanes and associated flooding (Germanwatch, 2017) as well as earthquakes and volcanic eruptions. Flooding risks are further exacerbated when natural assets like wetlands and regional watersheds are taken over by urban development. The urban poor are particularly vulnerable as they have few choices but to build homes in disaster-vulnerable areas of cities.

Strategically addressing all these urban infrastructure challenges simultaneously, considering the linkages among resource efficiency, inclusive development and disaster resilience, provides a once-in-a-generation opportunity to advance human and environmental well-being as the region develops new cities and retrofits existing ones. If the opportunity is missed in the coming few years, emerging ASEAN cities will be locked into current development patterns that are largely unsustainable, thereby limiting residents from reaping the full spectrum of health and well-being benefits that come with rising wealth.



© aldarinho/Shutterstock

C. Pathways for resource-efficient and inclusive urban development in the ASEAN region

This report highlights five strategic infrastructure pathways for resource-efficient and inclusive urban development. Building upon UN Environment International Resources Panel's (IRP) global report, *The Weight of Cities: Future Resource Requirement of Future Urbanization (2018)*, these pathways have great potential to be applied to diverse cities across the ASEAN region, as demonstrated by several successful case studies drawn from ASEAN cities and from urban areas in China and India. These pathways offer important opportunities to advance resource efficiency, providing opportunities for resource savings, economic savings, inclusive and equitable development, pollution mitigation and disaster resilience, and enhanced overall well-being of people and the planet.

PATHWAY #1

Undertake national and cross-ASEAN urbanization planning to balance economic growth across a range of city sizes while preserving high-value agricultural lands and ecosystem services.

PATHWAY #2

Promote compact, mixed-use, accessible, and inclusive urban form through urban-regional *and* city-level planning to reduce land expansion, streamline infrastructure provision, and promote diverse sustainable mobility options.

PATHWAY #3

Develop zero slum cities through inclusive land use planning that prevents slum formation, and in situ (or nearby) rehabilitation of existing urban slums in resource-efficient and disaster-resilient multi-storey construction.

PATHWAY #4

Promote resource-efficient and resilient buildings and electric-grid systems by leveraging advanced and vernacular building technologies[11], engaging user behaviours and cultural norms, and linking renewable energy in cities with the cross-ASEAN electric grid.

PATHWAY #5

Promote resource efficiency at the systems level across the city through innovative and profitable exchanges of "waste" energy and materials across industries and residential-commercial sectors.

The following pages present a brief on each of the pathways, outlining specific actions at multiple levels of government.

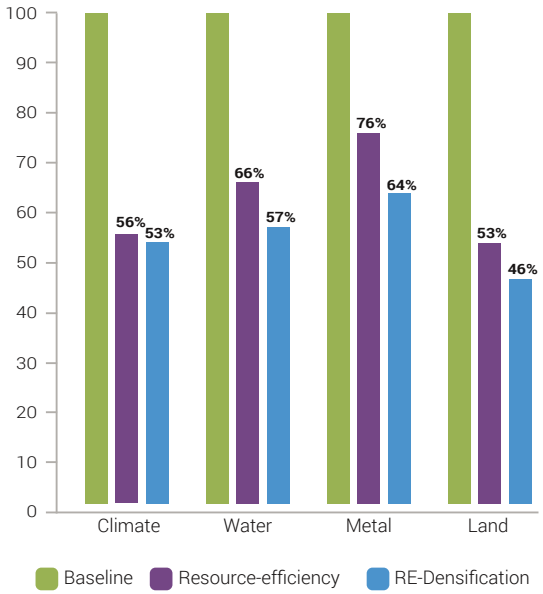
FINDINGS FROM THE GLOBAL WEIGHT OF CITIES REPORT

The *Weight of Cities* report recommends five broad urban land use and infrastructure strategies including:

- Avoiding urban area expansion onto agricultural lands and high value natural assets.
- Planning for strategic intensification and limiting urban sprawl.
- Promoting energy efficiency strategies in single sectors.
- Supporting cross-sectoral efficiency across urban areas and infrastructure systems
- Advancing urban experimentation to innovate on sustainable behaviour change, urban finance and multi-sector governance.

The report argues that **a factor of ten reduction in energy and material use is possible** from an original "business as usual" (BAU) scenario (representing 100 per cent resource use) through the above strategies (IRP, 2018).

Reduction potential of system-level transformation strategies



1 Vernacular design incorporates local tradition, climate and availability of construction materials. Vernacular buildings use passive design features leveraging local climate characteristics.

PATHWAY 1

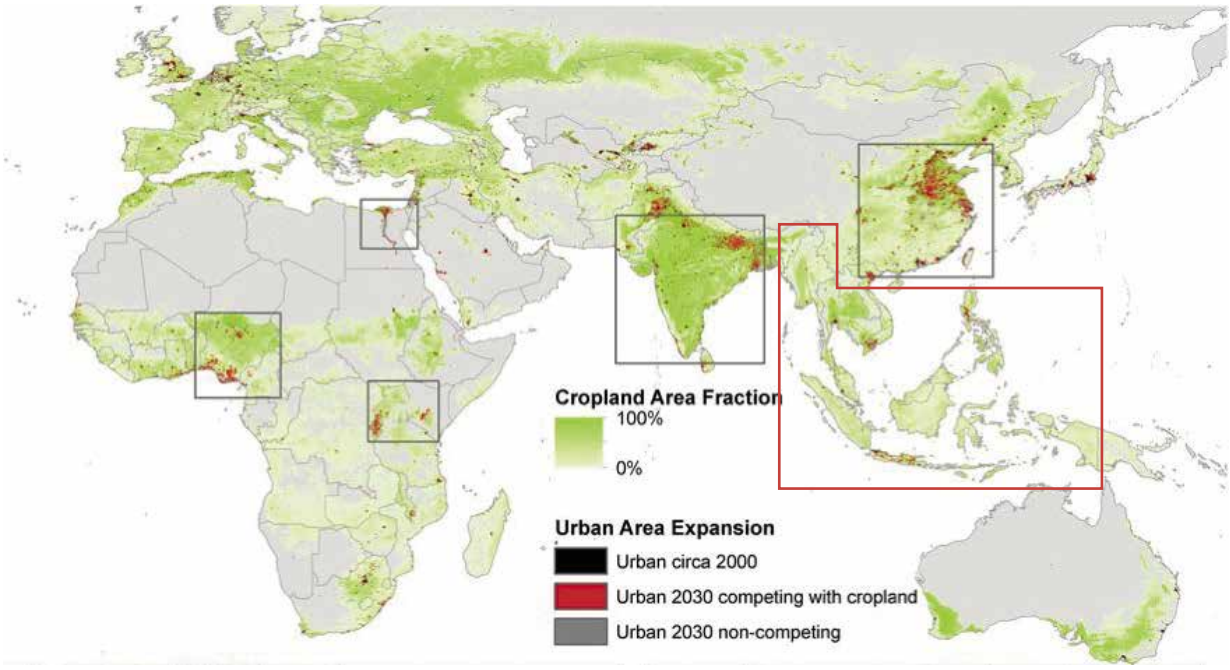
Undertake national and cross-ASEAN urbanization planning to balance economic growth across a range of city sizes while preserving high-value agricultural lands and ecosystem services.

National or cross-ASEAN urbanization and economic corridor planning is essential to balance population pressure and distribute economic development in a symbiotic manner across a range of cities – small, medium, and large – relieving growth pressure on megacities. Examples include the Singapore-Johor corridor in the ASEAN region, the Jing-Jin-Ji metropolitan region in China, and the Delhi-Mumbai industrial corridor in India. Higher overall economic efficiency can be realized if large cities focus on services and high-technology manufacturing, while small and medium-sized cities specialize in lower-technology manufacturing and agriculture-related industries (Lall and Wang, 2012).

Regional or national land-use databases should be developed to provide critical information on high-value agricultural lands, wetlands and biodiversity hotspots that must be protected from urbanization because they provide essential food security and ecosystem services to cities and rural areas alike. In the ASEAN region, in Viet Nam for example, agricultural productivity loss from urbanization could reach nearly 16%. In some countries, such as China, the national government has established ecological red-line policies that are then implemented at the regional level to ensure urbanization occurs in concert with preserving natural assets in the hinterlands.

National governments must empower and institutionalize the creation of urban development authorities that can act at the level of urban agglomerations to ensure that urban land expansion is minimized, while developing inclusive and compact cities.

Figure 5 • GLOBAL LOCATIONS WHERE PROJECTED URBAN EXPANSION THROUGH 2030 IS EXPECTED TO RESULT IN CROPLAND LOSS (*d'Amour et.al. 2017*)



The ASEAN region corresponds to the red box.

PATHWAY 2

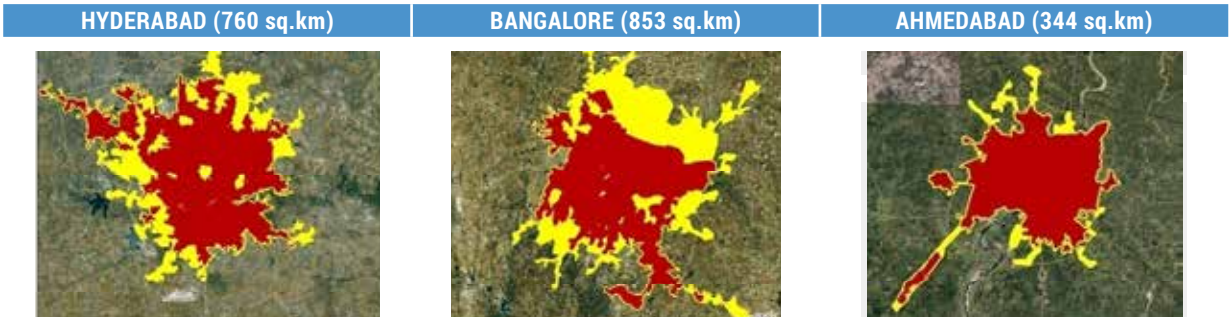
Promote compact, mixed-use, accessible, and inclusive urban form through urban-regional and city-level planning to reduce land expansion, streamline infrastructure provision, and promote diverse sustainable mobility options.

Guidelines for sustainable urban regional development should be institutionalized and enforced. Many ASEAN countries have advanced legislation on regional planning designed to limit urban sprawl, ensure planned urban infrastructure expansion, protect ecologically valuable hinterlands, and enhance rural-urban equity. The implementation of these laws is, however, challenging given the high level of informal urban growth. Enforcement of these laws should be a priority and can be strengthened through increased (vertical) integration of national and local policies, high levels of community engagement, and effective use of regulated and well-designed public-private urban development efforts.

Policy instruments such as land pooling and land readjustment should be used in innovative public-private-community partnerships to manage and coordinate urban expansion. These tools allow urban-regional and city governments to work with peri-urban land owners and private developers to aggregate land parcels to support planned urban infrastructure expansions such as roads and power lines. In successful examples of land pooling in India, rural land-owners have contributed a share of their land for planned infrastructure development while retaining a financial stake as the newly-urbanized land appreciates in value. Private developers often contribute the first cost of infrastructure development, while urban-regional or city authorities coordinate and regulate to ensure compact and **inclusive** urban development that preserves surrounding high-value land.

A success story of urban regional planning that has kept pace with rapid population growth can be found in Ahmedabad, India where the regional urban development authority has been effective in using land pooling to manage urban land expansion and reduce sprawl compared to other large cities in India.

Figure 6 • URBAN FORM ACROSS INDIAN CITIES (*Used with permission of Munshi, 2015*)



	HYDERABAD	BANGALORE	AHMEDABAD
Population Density (Urban Built in persons/sqkm)	10526	9378	17441
Population Density (Urban Sprawl in persons/sqkm)	6265	5869	15574
Compactness index	0.60	0.63	0.90
POPULATION (MILLION)	8.0	8.0	6.0

The Ahmedabad Urban Development Authority has used land pooling as part its town planning schemes to guide urban development. The results are evident in the compact urban form the city has achieved relative to other cities, minimizing sprawl and driving higher densities even in areas that are considered outside of the built-up urban areas of the city.

Urban-regional macro and micro plans should be integrated and embrace the goals of compact and inclusive development. Specific floor area ratios for new development can require a diversity of uses and support a range of densities, with land set aside for economically weaker sections to ensure that the urban poor and migrants are not pushed to the urban periphery (ESMAP, 2014). Such compact and socially mixed developments promote resource-efficient and vibrant neighbourhoods by generating the economies of scale essential for transit, and by investing in mid- and high-rise building construction that use land efficiently and require a third less material compared to single-storey construction.

Coordinated land use and transportation plans must support an articulated and accessible density that limits both urban land expansion and reduces the demand for motorized travel. Compact city planning around the 5D principles of **d**ensity, **d**iversity of uses, multi-modal **d**esign, short **d**istances to transit, and easy access to **d**estinations (primarily for jobs), can reduce motorized travel demand by 25 to 40 per cent in diverse world cities, thereby reducing congestion and air pollution.

Cities and nations must plan for diverse transit strategies in cities of different sizes. Mass transit strategies – some combination of bus-rapid-transit, light rail, or metro rail – will be more economically viable in larger cities (>0.5 million population). In smaller cities (population <0.5 million), relying on traditional bus systems supplemented with dedicated bicycle and pedestrian infrastructure may be more cost-effective (Shastry & Pai 2016). Public transit in cities of all sizes needs to be supplemented by a suite of multi-modal first-km/last-km mobility options including non-motorized travel and shared mobility option such as taxis, cycle rickshaws, tuk-tuks and para-transit.

Leverage vehicle-sharing practices with new technologies to unlock sustainable mobility options. Combining ride-sharing mobile phone business applications with electric vehicles can promote shared electric vehicles (SEVs) in cities, including e-rickshaws and e-taxis, which can reduce vehicles on the road and urban air pollution emissions. Policy frameworks will need to be designed carefully to ensure adequate life cycle management of batteries (production, use, and disposal) and the development of a low-carbon electricity grid that reduces life cycle fossil fuel use in EV operation by decarbonizing power generation.

Table 2 • ARTICULATED AND ACCESSIBLE DENSITY GUIDELINES FOR AVOIDING MEGA BLOCKS (*UN Habitat 2014, WHO 2016, Pongprasert & Kubota 2017, ESMAP 2014*)

Feature	Characteristics	Minimum Parameters
High Density Transit Nodes	Immediately surrounding transit station	15,000 persons/km2
Mid to High Density Neighbourhood Gradient	Neighbourhood areas interspersed between high density transit nodes	7,500 – 10,000 persons/km2
City-Wide Transit Access	Widely available transit station access throughout city linking housing, jobs, education, and commerce.	<1km distance, preferably 400-800m
Green Space Access	Neighbourhood parkland and open space	0.5-2 hectare site within 300m
Human Scale Blocks (No mega blocks)	Block design that is walkable, proportionally scaled, with frequent intersections and reasonable building setback in contrast to mega blocks	<150 m between intersections, 100+ intersections per km

Figure 7 • DEVELOPING ACCESSIBLE DENSITY BY AVOIDING SUPER BLOCKS, INSTEAD PRIORITIZING WALKABLE STREET GRIDS WITH REGULAR INTERSECTIONS (*ESMAP, 2014*)

	Turi, Estonia	Barcelona, Spain	Paris, France	Ginza, Tokyo	Pudong in Shangai, China	Towers North in Beiging, China
						
Intersections per km^2	152	103	133	211	17	14
Distance between intersections (m)	80	130	150	43	280	400

PATHWAY 3

Develop zero slum cities through inclusive land use planning that prevents slum formation, and in situ (or nearby) rehabilitation of existing urban slums in resource-efficient and disaster-resilient multi-storey construction.

Citizens living in informal settlements are uniquely vulnerable to climate change impacts. In the case of Southeast Asia, climate change has resulted in flooding, increased rainfall resulting in landslides, and stronger wind speeds during typhoons/hurricanes. All these have implications for the way cities are built and managed, specifically for those living in slum settlements in disaster-prone zones.

National governments must establish national "zero slum" urbanization policies implemented in conjunction with city governments to achieve the New Urban Agenda Goals of realizing "the right to adequate housing for all" in addition to equal access to "public goods and quality services" (UN Habitat 2017). National plans provide a roadmap and mandate for sustained action at all levels of government which can be used to coordinate policy efforts and leverage resources, expertise, and financing from both the public and private sectors. These efforts should simultaneously improve standards of living, increase resource efficiency, *and* reduce disaster risk vulnerability of slum residents. The Philippines and Indonesia are embarking on such national "zero slum" plans using a variety of financing mechanisms.

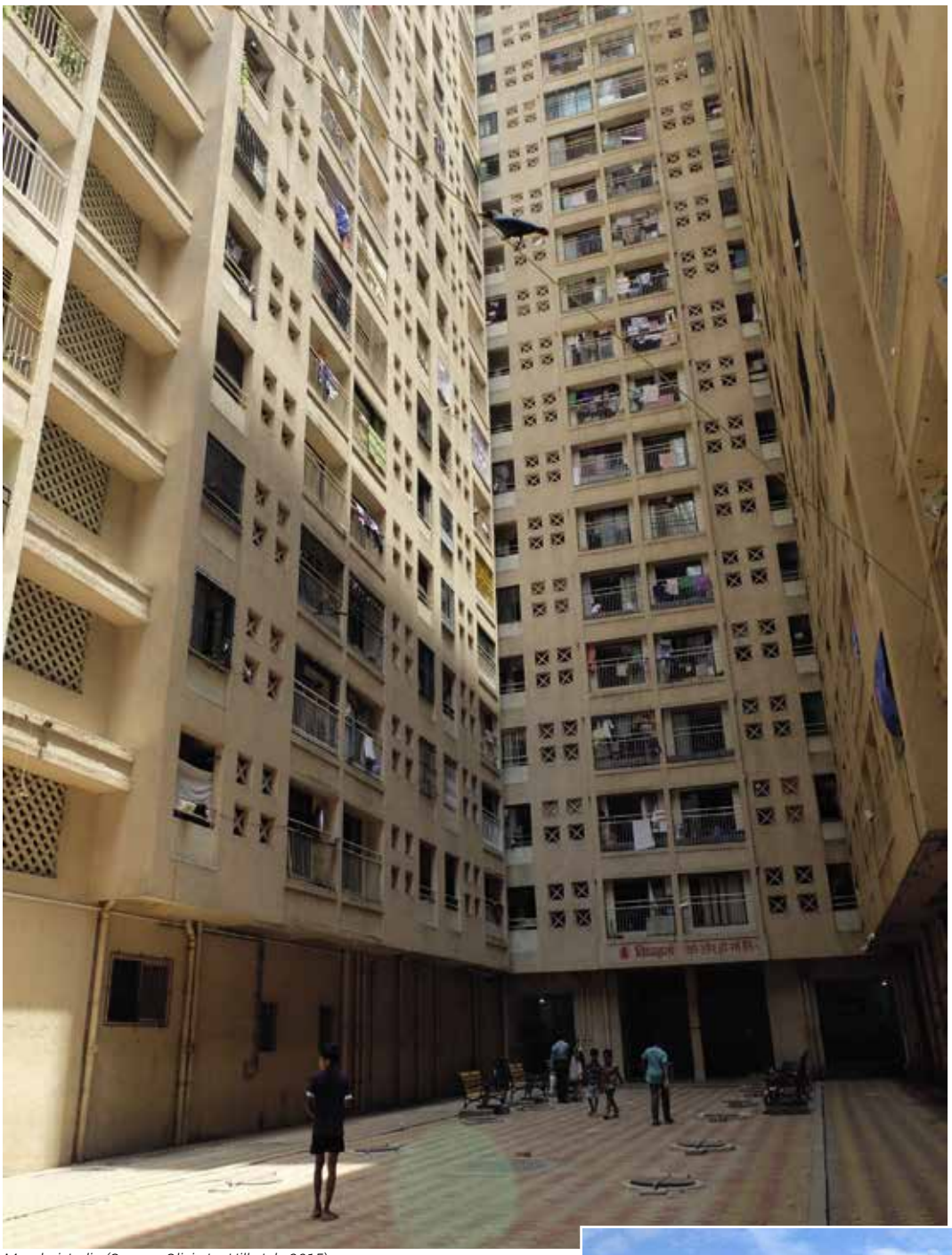
City and national governments should support "build back better" slum rehabilitation efforts after natural disasters that rely on building codes and standards to upgrade the quality, safety, resilience, and resource efficiency of new housing stock constructed. Few ASEAN nations have effectively developed building codes – for social housing or market-rate housing – that combine both disaster and energy efficiency standards to simultaneously reduce resource use and increase resilience. The integration of community-based design principles for local ASEAN construction into resilience and resource-efficient building codes and standards can increase compliance with and adoption of those standards.

City governments must establish requirements for fully integrative (non-peripheral) social housing as well as policies of in-situ or nearby multi-storey rehabilitation of existing slum residences. These actions support inclusive and compact development goals simultaneously. Allocating space in new development projects for migrants and the urban poor is important for preventing peripheral slum development. In addition, existing slums with poor housing within the city core can be rehabilitated in situ with multi-storey buildings using novel and culturally appropriate public, private and civil society partnerships with the slum residents themselves. Rehabilitation in multi-storey construction supports goals of articulated density and associated reductions in motorized travel demand, and it generally requires significantly fewer materials per housing unit than single-storey rehabilitation. Effective and culturally-sensitive in situ rehabilitation in multi-storey construction has been demonstrated in several recent case studies in India and the ASEAN region, using a mix of financial incentives and implementation by governments in coordination with the private sector.

KEY ENABLING FACTORS FOR IN SITU URBAN SLUM REHABILITATION AND RESOURCE-EFFICIENT CONSTRUCTION WITH LOW-POLLUTING MATERIALS

- Partnerships between government, builders and slum dwellers.
- Incentives to builders to finance slum upgrading, along with active participation of slum dwellers. Rehabilitation plans require consent of >70 per cent slum dwellers.
- Multi-storey construction enables rehabilitation in the city core and reduces material use by 36 per cent (UN Environment, 2017b).
- Construction with alternate building materials and technologies such as "green bricks" reduces air pollution emissions from manufacturing bricks (World Bank, 2011).
- Fly ash and steel slag cements reuse industrial waste, saving energy and virgin materials.
- Consider manufactured sand, lightweight concrete and other materials to battle sand scarcity.

Figure 10 • HIGH-RISE AND MID-RISE SLUM REHABILITATION IN INDIA AND INDONESIA.



Mumbai, India (Source: Olivia Lu-Hill, July 2015).

Indonesia (Source: Government of Indonesia, 2012)

PATHWAY 4

Promote resource-efficient and resilient buildings and electric-grid systems by leveraging advanced and vernacular building technologies, engaging user behaviours and cultural norms, and linking renewable energy in cities with the cross-ASEAN electric grid.

Compact resource-efficient cities must consider a mix of mid-rise and high-rise buildings using advanced and vernacular energy efficiency strategies. Mid- and high-rise buildings consume 30 per cent less materials than single-storey construction and are essential to achieve a compact city. Both modern high-rise and vernacular designs[2] adapted to mid-rise (4 to 5 storeys) construction, can reduce energy use by 50 per cent or more compared to their counterparts, if built to high-efficiency standards. Vernacular buildings are particularly important in preserving heritage in old city neighbourhoods in Asian cities.

ASEAN nations must develop region-specific green building codes for new and existing buildings that integrate new technologies with vernacular designs, and incorporate local cultural norms and behaviours. Although successful green building rating systems exist such as Singapore's Green Mark system, many ASEAN nation's building codes do not include standards for energy efficiency (International Energy Agency (IEA), 2015). Further, energy efficiency standards are typically for new construction, and do not address the many examples of existing and vernacular design that achieve high levels of resource efficiency through traditional architecture, passive design features, user practices and regionally available materials. Thus, it is important for the region to develop green building codes for new *and* existing buildings integrating high technology with vernacular design. It is also important to retain, through social norming campaigns, existing ASEAN cultural practices that conserve energy and promote sustainable behaviours.

A cross-ASEAN regional research centre and clearing house is essential to develop best practices and models for combining disaster resilience with green building design. The ASEAN region as a whole will continue to be impacted by typhoons, flooding, earthquakes and other natural disasters. The goal of compact, sustainable and resource-efficient cities requires mid- and high-rise buildings that are both resource efficient *and* disaster resilient. Few nations have innovations and codes to achieve these twin goals, particularly leveraging local vernacular and passive design. Pan-ASEAN research centres investigating the integration of vernacular and high-rise building design, combining disaster-risk resilience and environmental sustainability is essential to advance both goals.

All levels of government must institutionalize resource-efficient and disaster-resilient design guidelines into building codes, along with capacity building to implement, monitor and enforce. Building codes are not enough – implementation and monitoring is key (World Bank GFDR, 2016).

Figure 8a • A MODERN BUILDING WITH PASSIVE DESIGN ELEMENTS IN SELANGOR DARUL EHSAN, MALAYSIA
(Aga Khan Development Network, 2016)

Figure 8b • AN EXAMPLE OF VERNACULAR ARCHITECTURE IN PENANG, MALAYSIA
(Source: Omar and Syed-Fadzil, 2011)

2 Vernacular design incorporates local conditions such as climate, available materials, architecture design and lifestyle. They often consume much less energy than modern green buildings.

FIGURE 9 • ROOFTOP SOLAR WATER HEATERS/SOLAR THERMAL COLLECTORS (*YouGen United Kingdom)*

Nations and cities must also provide incentives to promote the high penetration of energy-efficient green building codes and appliances as well as the use of real-time monitoring for performance tracking. Singapore's experience with the Building Energy Submission System has shown that establishing codes alone may not ensure widespread adoption or actual energy use reduction. Incentives will be important to encourage builders to adopt green design concepts that incorporate user behaviours and monitor/report energy use.

The cross-ASEAN electric grid and renewable energy planning must also directly incorporate urban buildings and distributed energy systems. The cross-ASEAN electric grid is being planned with significant renewable energy targets, but coal will still be a dominant part of grid supply by 2050. Renewable penetration can be enhanced by intentionally including cities in renewable generation through renewable micro-grids, solar water heaters, distributed rooftop photovoltaic (PV) systems and geothermal energy, leveraging rich solar and geothermal resources in the region. Micro-grids that can be disconnected from the larger grid and operate autonomously increase resilience during disasters and other service disruptions. Vernacular buildings that incorporate rooftop photovoltaics and solar thermal water heaters may not need additional electricity for air conditioning and heating. Incentives such as feed-in tariffs can be provided to building owners to increase the adoption of residential and commercial renewable energy.

Consider district cooling for medium- to high-density areas. Cooling loads in the ASEAN are expected to be the largest factor contributing to electricity use, which is projected to triple in the region (OECD/IEA, 2015). Cities and institutions such as hospitals, universities and business parks may achieve high levels of cooling without relying on electricity by investing in cost-effective district cooling systems that use sea water and/or waste heat from local industries to operate chillers. District energy systems connect and cool networks of buildings using low-cost energy such as industrial waste heat (UN Environment, 2015).

PATHWAY 5

Promote resource efficiency at the systems level across the city through innovative and profitable exchanges of "waste" energy and materials across industries and residential-commercial buildings.

The ASEAN nations will see a large increase in industries, including heavy industries, that use a lot of energy, material resources and generate waste. Rather than focus only on treating industrial pollution and waste after it is generated, overall resource efficiency in cities can be enhanced by urban infrastructure planning that supports exchange of energy and materials across urban-industrial sectors.

There needs to be a better understanding of symbiotic interactions between urban infrastructure and industry. This can happen either through independent eco-industrial parks that share water, energy, and waste infrastructure, or by linking eco-industrial parks and individual industries within cities to larger urban infrastructure systems such as district energy and the urban construction sector. Specific actions to promote these interactions include:

Co-locate industries in eco-industrial parks, applying suitable institutional and regulatory frameworks. Co-location enables symbiotic sharing of by-products (waste-heat and materials) and utilization of common infrastructure for waste management across industries, reducing waste and pollution and improving profits. Institutional support is needed to establish the parks, and for regulatory oversight and performance monitoring to ensure no pollution is released. Eco-industrial parks can be particularly valuable in newly-industrializing cities to manage industrial resources and waste. The Tianjin Economic-technological Development Area (TEDA) in China is an excellent example of successful industrial symbiosis policies in action. Mandatory environmental disclosures and minimum performance standards increased participation and awareness of wastes and pollution emissions resulting in 29, 40 and 35 per cent decreases in freshwater consumption, wastewater

discharge and solid waste generation respectively. Sulphur dioxide emissions decreased by 49 per cent and energy use per industrial added value decreased by 11 per cent.

Plan urban infrastructure in cities using circular economy principles that promote cross sectoral urban-industrial resource and waste reutilization. Cities present powerful opportunities to beneficially exchange "waste" energy and materials across industry and building sectors. For example, low grade "waste heat" from industries can be transmitted efficiently over a distance of 30 km to be reused in advanced district energy systems that cool homes and offices in cities, displacing inefficient coal-fired boilers. Such cross-sectoral strategies, already being piloted in many cities of the USA, European Union, and China, realize energy-efficiencies at the urban systems level, beyond what can be achieved conventionally within single sectors (i.e., buildings or transportation), reducing air pollution, saving fuel and reducing carbon emissions. Urban-industrial symbiosis can also connect urban and rural communities by rural waste-to-energy conversion such as rice husk gasification, which is used in some regions of Cambodia and which can significantly reduce air pollution from open crop burning.

Figure 11 • RICE HUSK GASIFICATION IN CAMBODIA (*Alliance for Rural Electrification. (ARE, n.d.)).*

© Saravutpics/Shutterstock

D. Governance and finance innovation

To support the implementation of these strategic infrastructure pathways for inclusive and resource-efficient development, policy-makers at all levels of government will need to support innovative financing and governance solutions.

National authorities should establish a country-wide vision for urbanization that can help create shared cultures around sustainable urban development practice and management. A national urbanization vision presents an opportunity to outline best practices of sustainability coordination across administrative boundaries and across levels of government. UN Habitat has identified establishing a "national urban policy" as a critical part of advancing a country-wide vision for urbanization (UN Habitat, 2016a).

All levels of government must work towards institutionalizing horizontal and vertical policy integration across levels of government and policy domains to ensure that cross-cutting sustainability efforts are complementary and support shared goals. Where people live, where key activities of the urban-regional economy take place, and how people get around urban areas are inter-related dynamics. Treating them integratively – rather than separately – from a policy and planning perspective is critical for resource-efficient infrastructure provisioning.

National authorities should create centralized financing facilities for streamlining urban public private partnerships (PPP) and land value capture (LVC) mechanisms to help local governments leverage a strong regional economy to finance sustainable infrastructure development**.** There is an opportunity for national centres to provide expertise and resources to small- and medium-sized local governments to help facilitate strategically important PPP and LVC mechanisms for financing urban infrastructure development. While the region is well positioned to leverage PPP and LVC financing mechanisms, this does not release local or national governments from the responsibility of ensuring that PPP arrangements advance the public good and not just private gain. For this, robust governance, monitoring, and evaluation practices are necessary.

The ASEAN bloc should expand cross-ASEAN knowledge networks to focus on key urban development topics of common concern that will benefit from regional expertise to support informed action by policy-makers. ASEAN national governments should provide both expertise and training to bolster the capacity of local governments, especially small and medium-sized ones. Regional research centres for studying common urbanization challenges such as the increase of small cities, exposure to natural disaster and climate risk, and high levels of slum development would benefit diverse cities across the region.

© Sacha Fernandez

E. Conclusion

The above pathways work together to achieve many SDG goals as illustrated in Figure 12.

- By focusing on the provision of basic infrastructure and food supply in cities, particularly for the underserved, the SDGs related to water, sanitation, basic energy access, zero poverty and zero hunger can be addressed.
- By developing more resource-efficient cities, and by reducing resource throughput in cities, including reducing fossil fuel use, cities can reduce local air pollution, enhance local health and well-being as well as address global carbon emissions and climate goals. Likewise, by reducing land expansion and preserving ecologically valuable land and biodiversity corridors in hinterland areas, cities can play an important role in preserving biodiversity and croplands, shaping life on land.
- Most importantly, infrastructure is essential to spur economic development and innovation.

Overall, these linkages result in developing sustainable cities and communities and promoting sustainable consumption and production in the ASEAN region.

Figure 12 • CONNECTIONS BETWEEN CITY-LEVEL ACTION AND THE SUSTAINABLE DEVELOPMENT GOALS (*UN Environment, 2017*)

Action by multiple levels of government as well as international agencies will be needed to implement sustainable urban infrastructure transitions in the ASEAN region as summarized in the following table.

LEVELS OF ACTION FOR SHAPING INCLUSIVE AND RESOURCE-EFFICIENT URBANIZATION	
CROSS-ASEAN AND NATIONAL-LEVEL ACTION	Undertake cross-ASEAN urbanization and economic corridor planning to balance population pressure and distribute economic development.
	Develop international and national land-use databases to provide critical information on high-value agricultural lands, wetlands and biodiversity hotspots.
	Empower and institutionalize the creation of urban development authorities where there are none, and further strengthen those that already exist.
	Develop ASEAN region-specific green building codes for new and existing buildings that integrate new, efficient technology with vernacular designs and incorporate local cultural norms and behaviours.
	Establish a regional research centre and clearing house to develop best practices and models for combining disaster resilience with green building design.
	Directly incorporate cities and distributed energy systems in cross-ASEAN renewable energy planning.
	Implement national "zero slum" urbanization policies to provide high-level guidance and financing mobilization.
	Provide national institutional support and regulatory framework for eco-industrial parks and other waste-to-value urban-industrial symbiotic exchanges.
	Establish ASEAN-wide and country-wide visions for urbanization.
	Develop centralized financing facilities for streamlining public private partnerships (PPP) and land value capture (LVC) mechanisms.
	Expand cross-ASEAN knowledge networks on key urban development topics of common concern.
URBAN-REGIONAL AND CITY-LEVEL ACTION	Use policy instruments such as land pooling and land readjustment to manage expansion at the urban-regional level.
	Integrate urban-regional macro with micro township level plans to support goals of compact and inclusive development at the level of the urban agglomeration.
	Engage in capacity building and training to develop and implement urban-regional macro plans congruent with micro-planning at the neighbourhood or township levels as cities grow.
	Develop coordinated land-use and transportation plans at the city level that support articulated and accessible density to limit both urban land expansion and demand for motorized travel.
	Plan for diverse transit strategies based on the size and functionality of cities to enhance cost effectiveness while responding to local needs and context.
	Consider where district energy systems might be well positioned in the urban fabric to provide efficiency gains.
	Establish set-aside requirements in new developments for non-peripheral social housing and policies of in situ multi-storey rehabilitation of existing slum residences.
ACTION ACROSS ALL LEVELS OF GOVERNMENT	Consider how best to leverage new vehicle technologies and vehicle-sharing practices which can unlock sustainable mobility options across a range of city types.
	Provide incentives to promote the integration of energy-efficient construction, adoption of energy-efficient appliances, and use of real-time monitoring for performance tracking.
	Institutionalize resource-efficient and disaster-resilient design guidelines into building codes, along with capacity building to implement, monitor and enforce the codes.
	Use circular economy principles to promote cross-sectoral urban-industrial synergies to support waste reutilization.
	Work towards institutionalizing horizontal and vertical policy integration across levels of government and policy domains.

References

Alliance for Rural Electrification. (n.d.). IED - *Biomass gasification as a sustainable alternative for rural electrification Cambodia*. Retrieved from: https://www.ruralelec.org/project-case-studies/ied-biomass-gasification-sustainable-alternative-rural-electrification-cambodia

Aga Khan Development Network. (2016). *Menara Mesiniaga, Selangor Darul Ehsan, Malaysia, AKTC*. Retrieved from : http://www.akdn.org/architecture/project/menara-mesiniaga

D'Amour, C.B., Reitsma, F., Baiocchi, G., Barthel, S., Guneralp, B., Erb, C.H., Haberl, H., Creutzig, F., and K. Seto. (2017). Future urban land expansion and implications for global croplands. *Proceedings of the National Academy of Sciences*, 114(34), 8939-8944, doi: 10.1073/pnas.1606036114.

Energy Sector Management Assistance Program (ESMAP) (2014). *Planning Energy Efficient and Livable Cities, Mayoral Guidance Note #6*. The World Bank: Washington D.C. https://www.esmap.org/sites/esmap.org/files/DocumentLibrary/ESMAP_CEETI_MayoralNote_6_PlanningEE%20Livable%20Cities_optimized.pdf

Germanwatch. (2017). *Global Climate Risk Index 2017: Who Suffer Most from Extreme Weather Events? Weather-related Loss Events in 2015 and 1996-2015*. Retrieved from https://germanwatch.org/de/download/16411.pdf

Government of Indonesia. (2012). Country Report Indonesia Working Group 2: Upgrading of Slum and Informal Settlements. Retrieved from http://www.apmchud-jordan.com/CMS/UploadedFiles/f1f6976d-a48c-41f6-84f9-d582f91b757b.pdf

Hindman, M., Lu-Hill, O., Murphy, S., Rao, S., Shah, Y., and Zhu, Z. (2015). *Addressing slum redevelopment issues in India*. Ann Arbor, MI: Dow Sustainability Fellowship.

HV, V., Thompson, F. and O. Tonby. (2014). Understanding ASEAN: Seven things you need to know. McKinsey and Co. May 2014. Retrieved from http://www.mckinsey.com/industries/public-sector/our-insights/understanding-asean-seven-things-you-need-to-know

Institute for Health Metrics and Evaluation (IHME). (2016). Global Health Data Exchange, GBD Results Tool. http://ghdx.healthdata.org/gbd-results-tool

International Energy Agency (IEA). (2015). *Regional energy efficiency policy recommendations: Southeast Asia region*. Paris, France: International Energy Agency. https://www.iea.org/publications/freepublications/publication/RegionalEnergyEfficiencyPolicyRecommendationsSoutheastAsiaRegion.pdf

International Resource Panel (IRP). (2017). Assessing global resource use: A systems approach to resource efficiency and pollution reduction. Bringezu, S., Ramaswami, A., Schandl, H., O'Brien, M., Pelton, R., Acquatella, J., Ayuk, E., Chiu, A.S.F., Flanegin, R., Fry, J., Giljum, S., Hashimoto, S., Hellweg, S., Hosking, K., Hu, Y., Lenzen, M., Lieber, M., Lutter, S., Miatto, M., Singh Nagpure, A., Obersteiner, M., van Oers, L., Pfister, S., Pichler, P., Russell, A., Spini, L., Tanikawa, H., van der Voet, E., Weisz, H., West, W., Wijkman, A., Zhu, B., and Zivy, R. A Report by the International Resource Panel. United Nations Environment Programme, Nairobi, Kenya. [pp.]

International Resource Panel (IRP). (2018). The Weight of Cities: Resource Requirements of Future Urbanization. Swilling, M., Hajer, M., Baynes, T., Bergesen, J., Labbé, F., Musango, J.K., Ramaswami, A., Robinson, B., Salat, S., Suh, S., Currie, P., Fang, A., Hanson, A. Kruit, K., Reiner, M., Smit, S., Tabory, S. A Report by the International Resource Panel. United Nations Environment Programme, Nairobi, Kenya.

Lall, S. and H.G. Wang. (2012). China Urbanization Review: Balancing Urban Transformation and Spatial Inclusion. Washington, D.C.: The World Bank. Retrieved from http://documents.worldbank.org/curated/en/911841468027856267/pdf/678840BRI00PUB067903B0EYE0on0EA0no6.pdf

Lin, D. (2015). H*ow can South-East Asia close its infrastructure gap?* World Economic Forum. 20 April 2015. Retrieved from https://www.weforum.org/agenda/2015/04/how-can-south-east-asia-close-its-infrastructure-gap/

Munshi, N. (2015). Comparison with cities: Hyderabad, Bangalore, Ahmedabad. Presentation on behalf of Gujarat Urban Development Authority.

Omar, N. A. M., & Syed-Fadzil, S. F. (2011). Assessment of Passive Thermal Performance for a Penang Heritage Shop house. Procedia Engineering, 20, 203-212. https://doi.org/10.1016/j.proeng.2011.11.157

Organization for Economic Cooperation and Development/International Energy Agency (OECD/IEA). (2015). *Southeast Asia Energy Outlook*. Retrieved from: https://www.iea.org/publications/freepublications/publication/WEO2015_SouthEastAsia.pdf

Pongprasert, P. & H. Kubota. (2017). Switching from motorcycle taxi to walking: A case study of transit station access in Bangkok, Thailand. I*nternational Association of Traffic and Safety Sciences*, 41(4), 182-190. https://doi.org/10.1016/j.iatssr.2017.03.003

Ramaswami, A., Russell, A.G., Culligan, P.J., Sharma, K.R., and E. Kumar. (2016). Meta-principles for developing smart, sustainable, and healthy cities. Science, 352(6288), 940-943. http://science.sciencemag.org/content/352/6288/940.long

Seto, K.C., Guneralp, B., and L.R. Hutyra. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, 109(40), 16083-16088, doi: 10.1073/pnas.1211658109

Shastry, S. and M. Pai. (2016). The Role of Transportation in the Future of Urban Developing Asia: A Case Study of India. Pacific Energy Summit and World Resources Institute. Retrieved from http://www.nbr.org/downloads/pdfs/eta/PES_2016_working_paper_shastry_pai.pdf

United Nations Department of Economic and Social Affairs (DESA) Population Division. (2014). World Urbanization Prospects: The 2014 Revision. Retrieved from https://esa.un.org/unpd/wup/

United Nations Environment Programme (UN Environment). (2015). *District Energy in Cities: Unlocking the Potential of Energy Efficiency and Renewable Energy*. Retrieved from: http://staging.unep.org/energy/districtenergyincities

United Nations Environment Programme (UN Environment). 2017. *City-level action is critical to deliver against most SDGs*.

United Nations Habitat. (2014). *A new strategy of sustainable neighbourhood planning: Five principles – urban planning discussion note 3*. Nairobi, Kenya: UN-Habitat. https://unhabitat.org/wp-content/uploads/2014/05/5-Principles_web.pdf

United Nations Habitat. (2016). *National Urban Policy: A Guiding Framework*. Retrieved from https://unhabitat.org/books/national-urban-policy-a-guiding-framework/

United Nations Habitat. (2017). *New Urban Agenda*. Retrieved from http://habitat3.org/wp-content/uploads/NUA-English.pdf

World Bank. (2011). *Addressing Climate Change with Low Cost Green Housing: Identification of Low Cost Green Options and their Macro-Environmental Impact*. Washington, D.C.: World Bank. Retrieved from http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/Low_Cost_Green_Housing_Project_Report.pdf

World Bank. (2015). *East Asia's changing urban landscape: Measuring a decade of spatial growth*. Washington, D.C.: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/21159

World Bank GFDRR. (2015). Building regulation for resilience: Managing risks for safer cities. Washington, D.C.: World Bank.

World Health Organization (WHO). (2016a). *Ambient air pollution: a global assessment of exposure and burden of disease*. Retrieved from http://apps.who.int/iris/bitstream/10665/250141/1/9789241511353-eng.pdf

World Health Organization (WHO). (2016b). *Urban Green Spaces and Health: A Review of Evidence*. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0005/321971/Urban-green-spaces-and-health-review-evidence.pdf?ua=1

YouGen. *Solar thermal. YouGen UK*. N.p., n.d. Web. 11 July 2017.

For more information, contact:

UN Environment
Economy Division, Energy and Climate Branch
Cities Unit
1 rue Miollis, Building VII
75015 Paris
France

Tel: +33 1 4437 1450
Fax: +33 1 4437 1474

E-mail: economydivision@un.org
Website: www.unenvironment.org

UN environment

United Nations
Environment Programme

United Nations Avenue, Gigiri
P O Box 30552, 00100 Nairobi, Kenya
Tel: +254 720 200200
E-mail: communication@un.org
Website: www.unenvironment.org