

Exploring the Possibilities of Smart Urbanization in the Asia Pacific to Achieve Climate Change and Net Zero in Cities of the region: Challenges and Opportunities

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ABSTRACT

Asian cities currently contribute 80 percent of Asia's economic activity and account for 54 percent of the region's carbon emissions. By 2050, Asia's urban population could grow by 1.1 billion and reach 3.4 billion, which is the equivalent size of today's global urban population. In the absence of significant climate adaptation measures, the most significant increase in energy consumption and greenhouse gas emissions is expected to take place in Asian mega-cities. Existing infrastructure and urban development pathways could lock cities into unsustainable growth and consumption models, with worsening impacts on climate change. Hence, smart and effective urbanization is the order of the day and all measures need to be put in place to make the Asian cities smart, robust, livable keeping in mind the global issues of climate change. The future expansion of urban areas on agricultural lands and forests could also lead to the destruction of natural carbon sinks and important climate adaptation systems. Limiting climate change therefore means decarbonizing Asian cities. The good news is that there is a strong value proposition for Asian cities to accelerate their decarbonisation. Physical climate risks and their associated social and economic costs are already significant. Their impact, if unmitigated, could increase substantially, and have a material effect on Asia's 597 million urban poor. As the majority of Asia's economic activity takes place in cities and urbanization is still progressing fast, there is a significant opportunity to increase resource efficiency and transform Asian urban growth models to make them more circular, regenerative, and inclusive. It is seen that Asian cities contribute significantly to climate change, urban population growth, creates opportunities to decarbonize at scale, and that Asian cities are also exposed to climate risks.

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I. INTRODUCTION

The Asia Pacific region and the countries of the region are now at a critical juncture as the region is faced with the complex interplay of urbanization, climate change and biodiversity loss. This is an alarming situation given the crisis which the Asia Pacific region has been undergoing. Currently 50 percent of the population resides in urban areas. The total urban population is expected to grow from 2.5 to 3.5 billion by 2050. The region is confronted with the burgeoning crisis of climate change and it is already creating profound effects on the planet and its inhabitants. The region is prone to disaster risks caused due to severe cyclones, floods, hurricanes, tsunamis, earthquakes etc. Rapid urbanization in cities have resulted in severe climate shocks, as a result the region is highly vulnerable to climate impacts on critical infrastructure, transportation systems, water and sanitation facilities, health and livelihoods. Urban areas also contribute significantly to these climate-related challenges, as they produce 70 percent of global greenhouse gas (GHG) emissions, with their share continuing to grow at a rapid pace consistently. The region is a significant contributor to global GHG emissions, accounting for over half of the total worldwide emissions in 2020. The majority of these emissions are from urban areas, predominantly from the energy sector (73 percent) (UNDP, 2024), followed by sectors like transportation, manufacturing, construction and agriculture. If current trends continue, the region's emissions could nearly double by 2060. Despite commitments to carbon neutrality, current national actions outlined in the Nationally Determined Contributions (NDC) are insufficient to align with the goal of the Paris Agreement to limit global warming to 1.5°C above pre-industrial levels. A critical gap exists in integrating climate mitigation with other national policies, especially at the local level where technical and institutional capacities are often inadequate.

II. SCENARIO OF ASIA PACIFIC REGION

The significant demographic and economic shifts that come with urban growth can further contribute to climate change as well as create immense pressure on natural assets with further repercussions on the urban systems. The outcome of the 2023 global stock take on the implementation of the Paris Agreement noted with alarm and concern that the progress on mitigation is not on track towards achieving reductions in global greenhouse gas emissions of 43 percent by 2030 and 60 percent by 2035 relative to the 2019 level and reaching net zero carbon dioxide emissions by 2050. As such, the COP28 decision called on all Parties to make deep, rapid, and sustained reductions in greenhouse gas emissions to be in line with 1.5 °C pathways.

III. ISSUES AND CHALLENGES FACED BY THE ASIA PACIFIC REGION

3.1 Climate Change challenges

Asia-Pacific countries are already experiencing an increase in climate-related disasters, such as typhoons, floods, hurricanes, earthquakes, tsunamis and heat waves. These escalating risks, outpacing current adaptation efforts, are projected to intensify with the *IPCC Sixth Assessment Report 2023* indicating that extreme events will become more severe across all emissions scenarios. The region is expected to face potential GDP losses of 24 percent by 2100, disproportionately affecting the most vulnerable population. Urban areas, in particular, are constrained in their adaptation capabilities due to governance, financial and infrastructural limitations. The region is highly vulnerable to a variety of natural hazards, leading to significant loss and damage. This includes economic losses in South and South-West Asia and rising death tolls and affected populations in the Pacific. Addressing urban crises is essential, focusing on vulnerable and displaced groups. The recent establishment of a global loss and damage

fund has the potential to provide critical financial support to the most affected countries.

3.2 Biodiversity Challenges resulting in Unsustainable Agricultural Practices and GDP Losses

The Paris Agreement's global stock take underscores the need to synergistically address climate change and biodiversity loss. The Kunming-Montreal Global Biodiversity Framework Target 12 focuses on increasing green and blue spaces in urban areas to enhance biodiversity and human well-being. However, the region's biodiversity is under significant threat from deforestation, unsustainable agricultural practices and urbanization. This could result in potential GDP losses higher than the global average due to the substantial economic reliance of the region's food and agricultural sectors on natural resources. By 2100, an estimated 13 percent to 42 percent of all species in Southeast Asia are projected to be lost. Transitioning to nature-positive urban plans and investments is imperative. Key economic sectors, including food, land, urbanization, ocean use, infrastructure and energy, contribute to biodiversity loss, yet present opportunities for significant economic gains if managed sustainably.

The Asia-Pacific region faces formidable challenges in reducing GHG emissions, adapting to climate impacts, addressing loss and damage, and conserving biodiversity. Coordinated and ambitious efforts are essential to ensure the region's resilience and sustainability. The UN-Habitat role has been spelt out in terms of its implementation of various projects in the Asia Pacific region. The goals and ambition of the UN-Habitat ROAP (Regional Office for Asia and the Pacific) Accelerating Multi-level Climate and Urban Environment Action Programme for 2024-2030 are to have:

1. 200 plus cities across the region assisted on climate and urban environment actions
2. 30 plus member states supported in line with the UN-Habitat CCUE (Climate Change and Urban Environment) targets
3. USD 3 billion mobilized to support urban and urban-related climate and environment actions. This includes UN-Habitat implemented projects and projects for which

UN-Habitat has provided project preparation support.

4. 30 knowledge products released and issued in collaboration with 30 partner institutions.

3.3 Asia Pacific Cities are Diverse Complex Dynamic and Vulnerable to Climate Change

Asia-Pacific cities are diverse, complex and dynamic cities and are continuously evolving and growing. The issues confronted by the region are multifarious which include maximizing sprawl and maximizing resilience, making cities more resilient, embracing compactness for sustainability and resilience, compact development across neighbourhoods to mega cities and the applicability of the concept from neighborhoods to mega cities. The future of cities is not uniform across regions and can lead to a range of scenarios. While responding to climate change vulnerability and rising levels of inequality are global concerns, other issues are bifurcated by region. In developed countries, the key priorities for the future of cities also include managing cultural diversity, upgrading and modernizing ageing infrastructure, addressing shrinking and declining cities, and meeting the needs of an increasingly ageing population. In developing countries, urban priorities for the future are rising levels of poverty, providing adequate infrastructure, affordable housing and addressing challenges of slums, high levels of youth unemployment and investing in secondary cities.

IV. REVIEW OF LITERATURE

The review of literature on the topic of research have been obtained from secondary published sources by referring to publications of international organizations such as the GGGI (Global Green Growth Institute; Republic of Korea; Insight Brief No.9, June 2024, Urban Climate Action; Policy Brief Series; SDU, UNESCO, Accelerating Multi-Level Climate and Urban Environment Action; Priorities, Partnership, Resources, Proposals, UN-HABITAT, 2024, UNESCAP, 2024-2030; 2024, Crisis Resilient Urban Futures; The Future of Asian and Pacific Cities 2023; UN-HABITAT, UNESCAP, Asia Business Council ; (March 2023); Asia's Catalysts for Net Zero ; Berenice, Boets, Colleen, Howe and Janet Pau, Envisaging the Future of Cities ; World Cities Report, 2022; UN-HABITAT. These literatures are specific to the topic of research study as it covers aspects and challenges,

strategies adopted and plan of action for development of the Asia Pacific region in the long run.

V. RESEARCH METHODOLOGY IMPLEMENTATION AND RESULTS

To achieve the ambition that has been envisaged for the Asia Pacific region a multi-pronged development strategy needs to be put in place backed by the ambitious programmes and strategies adopted by the UN-Habitat, UNESCAP, ADB including undertaking projects in countries of the Asia Pacific region that are enlisted as follows:

1. Indonesia's US\$ 33 billion move to relocate its capital from Jakarta to Nusantara
2. Singapore's Climate Resilient Approach
3. Liuzhou, China's capital for electric vehicles
4. Surabaya, Indonesia's Testing Ground for Waste Management Solutions
5. Greater Bay Area became a leading innovation hub
6. Hydrogen Innovation Clusters in Japan and South Korea
7. In 1995, Malaysia inaugurated Putrajaya as its federal administrative capital, shifting some of its administrative functions to the new city, which is only 25 km south of Kuala Lumpur
8. The Government of Turkmenistan led an integrated multilevel governance approach to plan and implement the new city of Arkadag. Based on the concept of a compact integrated and mix-use development, the city is being built to have 64,000 inhabitants with the aim of promoting a high quality of life as the new capital city for the Ahal region.

To facilitate and achieve this ambition, UN-Habitat ROAP in partnership with ADB need to focus on five means of implementation namely, (i) City & Local Level Actions, (ii) National Level Support, (iii) Partnerships, (iv) Regional and Multi Country Actions and (v) Knowledge Management & Communication.

The implementation of the programme would seek to foster urban and climate sustainability principles that can be adjusted according to the challenges and realities faced in the areas of action. Monitoring, Evaluation and Learning (MEL) are key activities for this regional programme. The MEL approach for this programme will create

synergies with already existing activities and MEL systems at the national and regional levels. This would help maximizing the impact of on-going activities and complementing already established systems, especially those tracking the National Adaptation Plans (NAP) and Nationally Determined Contributions (NDC) with urban specific dimensions.

5.1 Lessons Learned from Regional Programmes

By highlighting lessons learned and emerging innovations from UN-Habitat's past and current initiatives at the country, regional, and global levels, the Regional Programme provides entry points to strengthen partnerships and multilevel actions in support of its implementation. The human-induced warming is causing climate change, which is already creating profound effects on the planet and its inhabitants. Climate change is now manifesting with increased mean temperatures, changes in rainfall and variability, sea-level rise, and disasters from heat and drought, wildfires, landslides, flooding, and other weather-related events. Urban areas and cities are highly vulnerable to climate impacts on critical infrastructure, transportation systems, water and sanitation facilities, health, and livelihoods. Urban areas also contribute significantly to climate related challenges, as they produce 70 percent of global GHG emissions, with their share continuing to grow. Without successfully addressing climate change issues emerging from and impacting urban areas, the targets of the Paris Agreement would be difficult to achieve. The projects implemented in Asia Pacific region enlisted above would go a long way in achieving rapid urbanization taking into account adoption of the aspects of climate adaptation and mitigation in the region.

Due to the strong inter-linkage between urban development, climate and natural systems, urban systems thinking is more than ever required to ensure aversion of locking-in cities and emerging urban areas into high emissions pathways and, critically, to avoid mal-adaptation. Failure to act will not only lead to further aggravation of climate change, but also trigger a chain of dire consequences including food insecurity, increased incidence of diseases, social instability, and irreversible loss of ecosystems and species. Whilst concerted global efforts are needed to address these challenges, climate

change impacts and urbanization challenges vary across the globe. Hence, nuanced approaches relative to national and local risk and emission

VI. LOSS AND DAMAGE CONCERNS IN RESPECT OF CLIMATE CHANGE IN THE ASIA-PACIFIC REGION

Now a days the greatest challenge in the Asia Pacific region due to climate disasters have resulted in calculation of the nature of loss and damage, which has been a topic of discussion/deliberations in the CoP meetings. The loss and damage varies across the sub-regions of Asia-Pacific. While South and South-West Asia are experiencing a substantial rise in economic losses and damages, the Pacific region is witnessing increasing trends of deaths and people affected. Moreover, while productive sector losses are highest in South-East Asia (80 percent of disaster losses), than in South and South-West Asia (60 percent) the loss in the Pacific region is (30 percent). Losses in the cross-cutting sectors (economic, social and infrastructure) are highest in the Pacific compared to the other regions. This finding highlights the importance of a comprehensive accounting of risks at the sectoral level for guiding adaptive measure to enhance future resilience (ESCAP 2022).

The Pacific Small Islands Developing States (PSIDS) based their call for a loss and damage fund with assumptions and evidence that loss and damage is a consequence of the failure to ramp up mitigation financing and actions that existing financial mechanisms established under the UNFCCC such as the Green Climate Fund (GCF) may have potential and growing policy pressure to help address elements of loss and damage. This will be unlikely to be institutionally able (due to donor preferences and expectations) to direct the scale of expertise, attention, and policy reform required to fund high trade-off issues. The need for additional financing to address loss and damage like financing for adaptation or mitigation will be targeted at nationally determined priorities and needs and not proposed to be a 'blank cheque' approach from which to price compensation for all climate impacts. The call for loss and damage financing must be distinct and additional to mitigation and adaptation financing; no singular fund under the UNFCCC is expected to provide a complete financial solution to loss and damage and

contexts must be strategically considered when adapting to climate change and promoting low-carbon pathways.

that a spectrum of arrangements will need be considered and linked to the central fund (*Policy Primer on Loss and Damage Considerations for Pacific Island Countries, UNDP 2023*).

6.1 loss and damage : country-specific issues on climate change

Advocacy on loss and damage is also being reflected in NDCs. About 60 percent of second-generation NDCs from 'climate promise' supported countries in the region refer to loss and damage. For instance, Sri Lanka included a chapter on loss and damage and identified NDC targets and actions for addressing loss and damage, while Pakistan included a section on loss and damage as part of means of implementation for its NDC. Nauru included loss and damage as one of eight areas that contribute to sustainable development. Vanuatu's NDC notes that loss and damage actions are part of the country's National Climate Change and Disaster Risk Reduction Policy while Nepal indicates that it will develop a national strategy and action plan on loss and damage by 2025. Cambodia, Myanmar, Viet Nam, Maldives, Lao PDR, and Tonga all speak to loss and damages occurring from increasing disasters and some countries have detailed cost estimates and systems for tracking this information (UNDP 2022).

Indonesia, Thailand, Vietnam, Philippines, Timor Leste and Bhutan are all members of the Santiago Network which catalyzes technical assistance for averting, minimizing and addressing loss and damage and proactively documenting and integrating loss and damage in their adaptation plans (UNFCCC).

Despite such exercises being conducted by the respective countries of the Asia Pacific region, the calculation of loss and damage on account of climate related disaster is yet to be finalized in the CoP meetings.

The Asia-Pacific region is rich in biodiversity, forests, coral reefs and large river basins and other key natural capital abound. However, issues and challenges loom as rapid deforestation, expanding agriculture, and urbanization create adverse effects to terrestrial, coastal and marine ecosystems.

Considering people's reliance in its natural capital, nature loss in the region will have result in economic activities losses, with as much as 63 percent (USD 19 trillion) of Asia-Pacific's GDP at risk a higher share than the global average (TEMASEK/WEF, 2021). Nature-positive urban plans and investments, with strong sustainability policies and regulations are needed in the region. Along with climate change, economic activities in three socio-economic systems have been identified as key contributors to biodiversity and nature loss: food, land, and ocean use; infrastructure and the built environment; and energy and extractive sectors. Nature positive transitions in these areas can add up to opportunities of up to USD 4.3 trillion in annual business value in 2030 for Asia-Pacific. This estimate is based on the WEF Report (2021) which further breaks it down as potentials of over USD 1.6 trillion of opportunities in the food, land and ocean use system (38 percent of regional total), over USD 1.2 trillion in the infrastructure and built environment system (29 percent), and over USD 1.4 trillion in the energy and extractives system (33 percent).

VII. KEY ASPECTS AND PARAMETERS OF ASIA PACIFIC REGION

7.1 Urban Heat Islands (UHI)

The Urban Heat Island (UHI) effect, where urban areas experience significantly higher temperatures than their surrounding rural areas, is a phenomenon that is primarily due to the high concentration of buildings, roads, and other infrastructures that trap and release heat, as well as the lack of vegetation and water. Climate change is exacerbating the UHI effect which is occurring in many parts of the globe due to urbanization. The Asia-Pacific region, which is undergoing rapid urbanization, is particularly vulnerable to amplified UHIs, which lead to not only heightened energy consumption and greenhouse gas emissions due to increased demand for air conditioning, but also threatens public health, particularly among vulnerable populations like the elderly, children and those with pre-existing health conditions.

UHI changes the local wind patterns, humidity, and precipitation rates, which can lead to the formation of heat domes over cities. These changes in the microclimate can disrupt local ecosystems and affect the city's overall livability

and sustainability. This UHI combined with climate change impacts affect local species' survival and reproduction rates, leading to a decrease in urban biodiversity ultimately limits ecosystem services that urban residents could benefit from. For example, Bangkok's Chao Phraya River in Thailand is experiencing increased temperatures due to the city's UHI effect. The thermal pollution has led to lower oxygen levels in the water, negatively impacting the river's aquatic life and contributing to harmful algal blooms.

7.2 Ecosystem Degradation

Terrestrial, coastal and marine ecosystems in the Asia-Pacific region are faced with growing threats from climate change and unsustainable urbanization. Urban growth often leads to land conversion and the loss of forests, wetlands, and other natural habitats, with consequent impacts on biodiversity and ecosystem services. Ultimately, urbanization pressures to biodiversity and ecosystems are also key to the constraint that limits the adaptive capacity of people and its spaces to adapt to and manage climate change impacts.

The rise in temperatures and increased instances of flooding can cause damage to road and rail infrastructure, disrupting supply chains and urban mobility. The long-term impacts of flooding and climate stressors can also alter land use due to abandonment of arable land and transformation of arable/ agricultural land to other land use types like residential blocks, industrial area, urban areas. For instance, the recent 2022 floods in Pakistan affected 33 million people and inundated 1.1 million hectares of cropland area in the Sindh province (ESCAP, 2023).

Climate actions and urban development needs to be biodiversity-inclusive and be designed with nature to improve urban health and quality of life. Green and blue spaces can provide important habitat for species, improve habitat connectivity, provide ecosystem services, and help manage impacts of extreme events brought by climate change.

7.3 Air and Water Pollution

Addressing air and water pollution is essential for achieving sustainable urban development and

mitigating climate change impacts in the Asia-Pacific. Megacities and urban regions in Asia and Pacific frequently experience episodes of extremely poor air quality, particularly during stagnant weather conditions. These episodes of air pollution are characterized by high outdoor or “ambient” concentrations of fine particulate matter (PM_{2.5}; aerosol particles with an aerodynamic diameter of 2.5 µm or less), which have serious effects on human health. Long-term exposure to ambient PM_{2.5} pollution was reported to be responsible for up to 3.6 million early deaths in Asia in 2019, which is around 80 deaths per 100,000 people. The overall ambient PM_{2.5} exposure risk has been increasing, with rises mainly occurring in countries with a low to middle socio-economic status e.g., countries in South Asia, and Southeast Asia (ESCAP, 2023).

Rapid urbanization and industrialization have like-wise led to significant water pollution due to solid and liquid wastes. This negative condition is exacerbated by climate change, compounding the risks felt by people and communities. The World Bank estimates that water pollution in the Asia-Pacific region costs around 1 percent of regional GDP annually due to health costs, reduced fish catches, and polluted water resources.

7.4 Water Scarcity

It is estimated by ADB that 3.4 billion people could be living in water-stressed areas in Asia by 2030 if no urgent measures are taken. This challenge on water stress and scarcity is further exacerbated by climate change and rapid urban development.

The reliability of water supply is affected by climate change due to the change in rainfall patterns, the occurrence of frequent droughts and floods. These climate change impacts coupled with demand from growing population and urban activities may result in water losses, contamination of sources and insufficient supply. In 2019, Chennai, India's sixth-largest city, made global headlines when it virtually ran out of water. The crisis was attributed to a combination of poor management, lack of rainfall, and rapid urbanization. Water scarcity has broad socio-economic impacts. It can lead to food and energy shortages, hinder economic growth and lead to political instability. Furthermore, it disproportionately affects the most

vulnerable populations who have the least capacity to adapt.

VIII. STRATEGIC FRAMEWORK AND ACTION AREAS

Given the challenges faced by the Asia Pacific countries due to natural disasters and calamities, strategies of development and adoption of action plans have been proposed for development of the region viz;

8.1 Facilitating Greenhouse Gas Emissions and Avoidance

This action area is focused on facilitating the reduction and avoidance of greenhouse gas emissions in the region, particularly in urban areas, through transformative change in energy, transport, waste management, building and construction, urban planning and design, as well as land use practices. It involves advancing low-carbon development pathways, promoting energy efficiency and carbon neutral technologies and processes as well as renewable energy.

8.2 Improving Resource Efficiency and Protection of Ecological Assets

This action area aims to improve resource efficiency in cities and protect valuable ecological assets to ensure their continued provision of vital ecosystem services. This involves enhancing urban planning and design, promoting sustainable consumption and production patterns, and integrating biodiversity and ecosystem considerations into urban decision-making to contribute to achieving the targets of the Kunming-Montreal Global Biodiversity Framework (2022), the Paris Agreement on Climate Change (2015) and the SDGs.

8.3 Advancing Adaptation Actions in Cities and human Settlements and Building Community Resilience

The action area of advancing adaptation actions in cities and human settlements involves prioritizing and integrating climate resilience into urban planning and infrastructure, safeguarding vulnerable urban populations and leveraging urban systems to enhance adaptive capacity. Result delivery will support accelerating urban actions towards achieving the targets of the Global Goal on

Adaptation and its framework.

8.4 Enhancing Knowledge and Actions to address Loss and Damage

This action area is focused on enhancing knowledge and actions to address loss and damage in the region through observing and anticipating urban loss and damage trends, advocacy, supporting partners to access loss and damage funding, and integrating loss and damage components in policies and NDCs.

IX. PROJECTS AND STUDIES UNDERTAKEN IN COUNTRIES ON UN-HABITAT ENGAGEMENT IN ASIA PACIFIC REGION

9.1 Mongolia Ger Community Resilience Project

The project aims to increase the resilience of communities to flooding by constructing physical flood infrastructure, improving sanitation services and increasing community awareness. The project focuses on engaging representatives of vulnerable community groups to identify and address their climate resilience needs.

9.2 Cambodia Climate Change Adaptation through Protective Small-scale Infrastructure Interventions in Coastal Settlements of Cambodia

The main objective of the project is to enhance climate change adaptation and resilience of the most vulnerable coastal human settlements of Cambodia through concrete climate change adaptation actions, particularly in areas where ecotourism has the potential to sustain such interventions. To achieve this objective, the project focuses its actions on highly vulnerable settlements in Kep Province and Prey Nob District of Preah Sihanouk Province.

9.3 Solomon Islands Enhancing Urban Resilience to Climate Change Impacts and Natural Disasters

In Honiara Solomon Islands, community level achievements include raised awareness of climate change and enhanced capacity to implement adaptation and climate risk reduction measures and increased adaptive capacity through community-level actions, such as mangrove

restoration, rainwater harvesting and early warning systems. At the city level, achievements include reduced risks associated with climate induced socio-economic and environmental losses through citywide governance and capacity strengthening and raised awareness of climate change adaptation and resilience safeguard project transparency.

9.4 Fiji Increasing the Resilience of Informal Urban Settlement

The project focuses on building resilience in informal settlements across four urban areas and towns in Fiji Lautoka, Sigatoka, Nadi and Lami which are located in the Greater Suva Urban area.

9.5 Sri Lanka Build resilience to climate change addressing drought, landslides and sea water intrusion for vulnerable upland and coastal settlements

The overall objective of the proposed project is to support climate resilient development and increase capacity for climate change adaptation of target communities living in the Mullaitivu District. The project will provide both increased cash income of communities through improvement of livelihood and improved resilience through small-scale infrastructure and will contribute to the generation of evidence-based practices. The project aims to benefit more than 12,000 individuals directly and 16,000 indirectly.

X. ASIAN CITIES ARE IN THE FRONT LINE OF CLIMATE CHANGE

Asian cities are a key contributor to carbon emissions. They are also on the front lines of the growing physical risks associated with climate change. Consequently, Asian cities must play a critical role in the fight against climate change.

10.1 Cities contribute significantly to Climate Change

The World Bank's Climate Change Action Plan (2021–2025) identifies cities as one of five key systems that generate the most greenhouse gas (GHG) emissions. More than 80 percent of Asia's economic activity (GDP) is concentrated in cities. Between 2000 and 2015, the urban share of regional GHG emissions in Asia increased from 46 percent to 54 percent, and average per capita

urban GHG emissions increased 72 percent from 3.0 to 5.1 tCO₂-equivalent per person. With moderate to low mitigation efforts, this share will increase steadily through 2050.

Asia's rapid urbanization has also resulted in significant land use changes and the destruction of natural carbon sinks and adaptation systems. The future expansion of urban areas could take place on agricultural lands and forests, leading to the loss of carbon stock and carbon sequestration capacity. In the years to come, the most significant increase in energy consumption and greenhouse gas emissions in Asia is expected to take place in mega-cities.

The growth of an increasingly affluent urban population will lead to the rapid expansion of housing and infrastructure. Existing infrastructure development and growth patterns could lock cities into unsustainable energy, and production and personal consumption models that could worsen climate change. Hence, limiting climate change means decarbonizing Asian cities and evolving their development pathways.

10.2 Urban Population Growth Creates Opportunities to Decarbonize at Scale

Since the 1950s, people have been moving to urban areas in search of better economic opportunities, services, and education, prompting Asia's rapid and continuous urbanization. Cities in Asia have been driving global urban growth. By 2050, seven out of 10 people will live in cities globally.

Asian cities are home to 2.3 billion people, which is more than twice the size of the entire population of the United States and the European Union combined. By 2050, Asia's urban population alone is projected to reach 3.4 billion which is equivalent to size of today's global population.

Accordingly, Asian cities will account for a big part of the growth in CO₂ emissions in the coming decades unless they take strong climate action. With 66 percent of Asia's population projected to be living in cities by 2050, there is an opportunity to transform growth models and decarbonize at scale.

XI. TYPES OF RISKS IN ASIA PACIFIC REGION

11.1 Floods

According to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC6) and to the World Meteorological Organization (WMO), sea levels in Asia Pacific have risen faster than the global average and the rise is accelerating. In 2021 alone, an estimated 21.3 million people in Asia were affected by floods, most of them urban residents. In the absence of effective adaptation and mitigation measures, an estimated 300 million could be exposed to flood risks and the cost of floods will continue to increase. The rapid cave-in of land in several Asian cities is compounding risks. Recent satellite data shows that land subsidence rates in cities like Tianjin, Chittagong, Manila, Karachi, Taipei, and Mumbai are several times the mean sea level rise.

11.2 Droughts

In 2021, an estimated 23.2 million people in Asia were directly affected by the reduced availability of water, including for irrigation. Economic damages increased 63 percent compared to the previous 20-year average, according to the UN-ESCAP. Droughts will continue to exacerbate food, water, sanitation, and energy security risks in Asia. By 2050, rice, soybeans, wheat, and maize prices are projected to rise due to lower yields. Much of ASEAN and South Asia have become water and food security "hotspots." This will create supply challenges for cities that will comprise 66 percent of Asia's total population by 2030.

11.3 Heat Waves and Heat Stress

These are also intensifying, particularly in cities where they are compounded by the heat island effect. By 2050, Central Asian cities could see temperature increases of 6°C or more. The International Labor Organization (ILO) estimates that a global average temperature increase of 1.5°C by 2030 will affect productivity through a 2.2 percent loss of total working hours due to heat stress. Asia's poorest economies where more people work outdoors will be most affected. Effective climate action could reduce social inequalities.

XII. ASIAN CITIES CONTRIBUTION TO CLIMATE RESILIENCE

12.1 Singapore's Climate Resilience Approach

Singapore placed first in the latest Notre Dame University's Global Adaptation Initiative (ND-GAIN) index for taking an effective whole-of-government approach to building resilience. The Building and Construction Authority (BCA) has restored Singapore's shoreline with a geo-bag seawall system and over 70 percent of Singapore's coastline is now protected against floods and soil erosion with hard structures such as seawalls and rock slopes. The National Parks Board (N-Parks) has also restored mangrove areas to help reduce shoreline erosion.

New reclaimed land and roads near coastal areas have been raised to protect them from sea level rise. The Maritime Port Authority of Singapore has protected existing port facilities. Singapore's fifth airport terminal is being built 5.5m above the mean sea level. The resilience of power stations and electricity grids, and that of telecommunications infrastructure, including mobile and broadband networks, has also been enhanced. The Land Transport Authority has installed flood barriers at various low-lying underground subway stations and sea level rise projections are being factored into the design of new stations. Minimum height requirements have been set for the entrance levels of buildings. BCA is reviewing strategies to address the increased risk of slope failure due to floods.

Singapore has also significantly upgraded its drainage system. The National Water Agency (PUB) has widened and deepened existing drains and canals and built diversion canals and centralized detention tanks. An underground tunnel and reservoir system is now under development to bring excess storm water into caverns for storage. Significant upgrades to the drainage system at Changi Airport are also in progress. Buildings are required to install detention tanks or green roofs, to slow runoff entering the public drainage system. Singapore is pursuing a "City in a Garden" approach, leveraging trees and biodiversity to provide shade and cover from the weather. About a third of the island is covered by trees. By 2030, 50 percent more land around 200 hectares will be set aside so that every household lives within a 10-minute walk from a park. One million trees will be

planted across the island to sequester another 78,000 tons of CO₂, provide cleaner air and cooler shade, and moderate the rise in urban heat. Besides expanding Singapore's tree cover, N-Parks also established a marine park to protect rare and endangered marine species. Singapore's Civil Defense Force is also stepping up patrols at fire hotspots. Together with N-Parks and the Meteorological Services Singapore, they are developing a Fire Probability Index to measure the risk of bush fires for different areas.

12.2 Liuzhou: China's capital for electric vehicles

The city of Liuzhou in Guangxi, China, is an example of how local authorities worked with multiple stakeholders to encourage the use of EVs for a cleaner environment. With EVs accounting for almost 30 percent of car sales, more than five times China's national average, Liuzhou now serves as a blueprint for other cities that are looking to achieve similar objectives. While Liuzhou residents were initially concerned about safety, the National Development and Reform Commission worked to ensure that they would see the convenience and benefits of using EVs. The first step was a complimentary 10-month test-drive public-private partnership campaign in 2017, after which as many as 70 percent of participants purchased an EV. The campaign was carried out by SAIC-GM-Wuling, a joint venture involving SAIC Motor Corp. and Guangxi Automobile Group and US based General Motors. Financial incentives and convenience also played an important role. EVs can be purchased from US\$4,500, and charging, which can be done from a household socket, costs just 0.1 yuan or 2 cents per kilometer. Unlimited free parking is available at certain lots.

12.3 Surabaya: Indonesia's testing ground for waste management

Indonesia's second largest city Surabaya offers lessons to other cities for its innovative and community-led approaches to waste management. Back in 2004, Puskota, a local non-profit organization, joined hands with Japan's Kitakyushu International Techno-cooperate Association (KITA) to carry out a pilot program for quick and affordable household composting in one of the city's low-income neighborhoods located near an industrial area.

The plan was for pre-sorted organic waste to be transported to a nearby composting center which would produce large quantities of high-quality compost to be sold to farmers and vendors. While the pilot project initially faced obstacles such as residents' unwillingness to separate waste at the source, community participation gradually increased, resulting in a cleaner and greener environment.

Surabaya then worked with other non-profit organizations to scale up the new waste management system. With one compost bin for every ten households, a soft infrastructure was established to help families share information and learn about the benefits of household composting. Surabaya also held competitions for the cleanest district in partnership with media partners to strengthen community participation. In 2013, a collaboration with Japanese company Nishihara also resulted in a "Super Depo" that not only separates waste into various categories but also created jobs.

Surabaya has also developed eco-parks as part of its greening efforts. Ten years after the closure of the Keputih landfill, the Institute of Technology Sepuluh Nopember (ITS) examined the soil and concluded that the area was cleared of harmful methane gas. The site has been transformed into Harmoni Park, a garden tourism attraction for local families and visiting tourists alike. Similarly, a former fishpond and an unmanaged area were converted into the Urban Forest of Gunung Ayar and the Wonorejo Mangrove Forest, respectively.

XIII. POLICY ACTION REQUIRED TO UNLOCK GREEN FINANCE

Asian financial centers must provide sustainability leadership to support the growth of green finance. Several priorities stand out which are enumerated below:

13.1 Policy clarity and coordination

Policy clarity is needed to reduce transition risks. Asian municipal governments should clarify their roadmaps to net zero and explain where they intend to go with carbon pricing, different industries, technologies and regulations. They should also define clearer pathways to decarbonize

brown industries and existing assets, to enable the development of responsible transition

13.2 Facilitate and mandate disclosures

Climate disclosures support well informed investment decisions and proper capital allocations. Increasing access to timely and comparable climate data and analytical tools would facilitate disclosures and increase their reliability. The International Sustainability Standards Board (ISSB) in February 2023 approved a global baseline for disclosures: the International Financial Reporting Standards (IFRS). Asian financial centers should agree to follow the IFRS to facilitate disclosures, reduce disclosure costs and increase transparency. Currently, regulators in major Asian financial centers mandate disclosures on a 'comply or explain' basis for listed companies, but not for banks and financial institutions. In cities that strive to be green finance centers, publicly listed and locally headquartered companies should be required to disclose verified climate information, including for Scope 3 emissions, to set science-based targets, and to provide information about their transition plans.

Financial institutions should be required to disclose their portfolio emissions. Regulators should also encourage disclosures by non-listed companies and SMEs. Exempting these firms risks encouraging "brown-spinning," whereby companies exempt from disclosure requirements buy up carbon-intensive assets.

13.3 Strengthen oversight of green financial products

Asian financial centers have not yet adequately tackled greenwashing in green financial products. Verification systems and information disclosure requirements largely remain weak. Banks from China and Japan are still topping the list of lenders to carbon-intensive industries. Issuers should be required to communicate transparently about their methodologies to create green indices and funds, as well as their portfolio composition. Regulators should also mandate that issuers set Science-Based Targets (SBTs) for their portfolio emissions and disclose verified climate information using IFRS-aligned metrics.

13.4 Promote transition finance

Western taxonomies support the allocation of

capital towards climate mitigation projects. Asia is at a different stage than the West in its journey to decarbonization. In addition to promoting climate mitigation, Asian taxonomies should therefore also enable investments in effective, verifiable and time-bound transition projects. Singapore and ASEAN are developing "traffic light" systems, metrics, and thresholds to support the decarbonization of selected carbon intensive sectors. Hong Kong is planning to develop a transition taxonomy. The criteria, definitions and thresholds used to identify, describe, and classify transition activities will need to be clear, supported by evidence, and aligned across the region. Verification safeguards will help minimize greenwashing risks.

13.5 Address knowledge and capacity gaps

Building talent and strengthening the capabilities of bankers, insurers, and asset managers in green finance, and of companies to disclose and manage climate risks, is essential to accelerate the development of green finance in Asia. Initiatives are underway across the region. These should be scaled and integrated, and access costs lowered, to accelerate talent development across Asia. Training should address broad environmental and social challenges, not just climate ones, to help meet the UN-SDGs.

13.6 Issues concerning definition of urbanization

One challenge in defining urban areas is the lack of consensus on the definition of "urban". The classifications vary from country to country. The Asia-Pacific region has an extraordinarily diverse number of urban forms, ranging from megacities to peripheral settlements. In this context, defining what constitutes "urban" is difficult as the breadth of scale blurs the boundaries between city and country-side making the traditional distinction less meaningful. A settlement of 10,000 people, for example, may be classified as being urban even though it may have more in common with its rural surroundings than a megacity of millions.

The twin challenges of diversity of urban definitions at the national level and the lack of a clear line between urban and rural communities prompted the international community to develop a globally harmonized method to define urban and rural areas. Through this commitment, which was

led by UN-Habitat, the European Commission, the Food and Agriculture Organization of the United Nations (FAO), the Organisation for Economic Co-operation and Development (OECD) and the World Bank, after through extensive consultations with countries, a globally harmonized method to define urban and rural areas was officially adopted by the United Nations Statistical Commission in 2020. The method, titled the degree of urbanization (DEGURBA) (European Union and others, 2021), establishes similar thresholds and an easy to implement workflow for defining settlements, and identifies a system of settlements along the urban-rural continuum, solving the long-standing challenge of binary urban-rural classifications that distort urbanization trends across countries. The degree of urbanization classifies the entire territory of a country along the urban-rural continuum. It combines population size and population density thresholds to capture the full settlement hierarchy (European Commission, 2020).

More than 50 countries have directly applied the method, including countries from the Asia-Pacific region. They value this approach to improve their understanding of urbanization processes and the production of comparable data within and across territories.

The response of the Asia-Pacific region to urbanization is still evolving within the context of a post-pandemic recovery. Some countries have historically discouraged the growth of their towns and cities through "ruralisation" programmes or restrictive registration systems. The COVID-19 pandemic has resulted in a decline in the use and economic value of urban central business districts due to hybrid and remote work transitions.

13.7 Cities and the Planetary Crisis

Though cities are often associated with negative environmental impacts, well-managed urban areas can benefit the planet. Among other potentially positive outcomes, cities and towns can promote more compact land use and deliver better access to essential services, such as sanitation, waste management and public transport. They can also provide the necessary scale for energy-efficient services and infrastructure, resulting in lower per capita emissions. Urban areas are ideally suited for financing and implementing green technologies that can lower per capita fossil

fuel consumption (UN-Habitat, 2022). Rising sea levels, coastal erosion, heatwaves, bushfires and the increased intensity of precipitation and storms are expected in the coming years (IPCC, 2021). The relative sea level in the region has increased more rapidly than the global average and countries are experiencing coastal area loss and shoreline retreat (IPCC, 2021). This increases cities' vulnerability to storm surges, coastal inundation and saltwater intrusion into aquifers, leading to loss of life and biodiversity, billions of dollars of losses and damage to infrastructure. As informal settlements are often in areas that are flood prone, poorer sections of the population are more vulnerable to the effects of rising sea levels. Exclusionary urban planning and limited investment in infrastructure development increase cities' risks of losses from extreme weather events.

XIV. CONCLUDING OBSERVATIONS AND LIMITATIONS OF THE STUDY

Asia's rapidly growing cities are faced with critical developmental choices. They are racing against time to mitigate and adapt to climate change, in order to reduce its worst impacts and ensure sustainable growth by addressing the challenges of rapid urbanization and climate change concurrently. While local leadership will be essential to achieve strong results, so will collaboration. Asian cities rely heavily on natural capital and external supplies for food, construction and other activities. Therefore, partnerships with suppliers will be required to reduce emissions along their critical value chains. Partnerships between Asian municipalities and with international development organizations, multilateral development banks, national and regional governments, local businesses and civil society will enable Asia's systemic urban transformation and the mobilization of capital to support it. Western governments will also have an important role to play in enabling investments in transition projects, considering the impact of their taxonomies on capital reallocations in Asia. Regional collaboration will be required to support climate innovation and enable green capital flows across the region. Doing so, will strengthen the capacity of Asian cities to work toward a sustainable transformation, securing a more prosperous and equitable future for their populations. It is observed from the study that climate adaptation being responsive measures are more important to be adopted than climate mitigation strategies in the

Asia Pacific region, which are corrective measures only.

The limitations of the study is that there is no quantitative analysis of the parameters that account for the burgeoning climate crisis in the Asia Pacific region. This is due to non-availability of data on these parameters on a continuous time-series pattern. The specific projects that are undertaken in the respective countries in the region may not represent the entire region. The greatest limitation from which the study suffers is that the calculation of loss and damage with respect to climate fund is yet to be determined country-wise due to data limitations, though this aspect is deliberated in CoP meetings.

XV. REFERENCES

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