Urban Nexus Policy Brief 2019

Urban Nexus Approach: Integrating and Strengthening City Efforts towards National and Local Climate Actions

Key messages

- ✓ The Asia-Pacific region is the world's largest emitter of GHGs, and its cities account for a major share of these emissions. Out of the top 10 CO_2 emitting cities globally, six are located in the region. Asia-Pacific cities have key roles to play in achieving the 1.5°C/2°C global climate targets.
- ✓ A total of 45 countries in the Asia-Pacific region submitted their Nationally Determined Contributions, with specific commitments to reduce GHG emissions. To achieve either the 1.5°C or 2°C global targets and NDC targets, mitigation actions must be taken in and by cities.
- ✓ The urban nexus approach can help urban stakeholders understand sectorial interlinkages and opportunities for selecting and implementing resource-efficient, cost-effective interventions that contribute to GHG mitigation targets and other sustainable development targets.
- ✓ The urban nexus approach supports cities to become more resilient towards inevitable climate change with regard to preventive technological concepts as well as governance aspects.
- ✓ To implement the urban nexus approach for achieving NDCs, national climate actions should be developed in tandem with local targets through a bottom-up approach which can ensure synergistic local nexus.
- ✓ Practical methodologies and MRV frameworks should be developed for systematic accounting of climate change mitigation and adaptation contributions by urban nexus projects in relation to the NDCs.

1. Introduction

The Paris Agreement on climate change set ambitious targets to hold the increase of global average temperature to well below 2°C above pre-industrial levels (Article 2) and strengthen efforts to limit the global temperature increase to 1.5°C above pre-industrial levels. To achieve these ambitious targets, the Paris Agreement requests all parties to implement domestic mitigation measures (Article 4). Nationally Determined Contributions (NDCs) on greenhouse gas (GHG) reduction targets and their implementation are expected to play a major role in achieving the global climate targets.

german cooperation DEUTSCHE ZUSAMMENARBEIT
Implemented by giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
UNITED NATIONS ESCAP Economic and Social Commission for Asia and the Pacific
ICLEI Local Governments for Sustainability Southeast Asia

The Asia-Pacific region is the world's largest regional emitter of GHGs, accounting for more than 50 per cent of total global emissions[1]. Urban areas in the region have huge carbon footprints, as they are responsible for most of the region's economic production. The region's cities are expanding both in size and number at an unprecedented rate. Since 2000, urban population has increased by 630 million, and by 2018 Asia-Pacific cities housed almost half of the world's urban population. It is projected that two out of three people in the region will live in its cities by 2050[2] . Rapid growth in GHG emissions from cities can be expected as a result of increasing concentration of production activities in urban areas and high-consumption lifestyles associated with growing affluence. In addition, cities are most vulnerable to climate change and already experiencing its impacts, as well as disasters resulting from floods, droughts, landslides and strong typhoons.

Actions by and in Asia-Pacific cities will be critical to achieving the 1.5°C/2°C global targets as well as national and local climate change targets. The importance of actions by and in cities has been acknowledged in the United Nations Sustainable Development Goals (SDGs), adopted in 2015, as well as the New Urban Agenda, endorsed by the UN General Assembly in 2016. Targets of SDG 11 on sustainable cities and human settlements relevant to climate change mitigation and adaptation include sustainable transport systems, green buildings, and reduction of environmental impacts of cities. The New Urban Agenda also includes specific commitments to reduce GHG emissions in all relevant sectors in line with the Paris Agreement.

City administrations, however, face barriers to identifying, planning and implementing climate change actions. In developing countries these are often associated with inadequate institutional, technical and financial capacities. To overcome them, identifying solutions that not just reduce emissions but also enhance adaptive capacity and resilience of cities to climate change is necessary.

The urban nexus approach can help develop such solutions as it involves identifying, understanding and acting on interrelationships among urban sectors. Urban nexus has the potential to provide cost-effective, environmentally friendly solutions, while generating benefits for multiple sectors. Promoting the nexus between urban sectors can contribute to global, national and local climate mitigation targets and strengthen adaptive capacity and resilience of cities to cope with climate change and, more generally, can contribute to sustainable development.

[1] https://www.climatewatchdata.org/ghg-emissions?sectors=411

[2] https://www.unescap.org/sites/default/files/The%20State%20of%20Asian%20and%20Pacific%20Cities%202015.pdf

Box 1: Urban Nexus

"The Urban Nexus approach examines the interdependencies between water, energy and food/land and the synergies and competing uses of these resources, requiring a shift from a sectoral to a cross sectoral, integrated approach. It challenges existing structures, sector policies and procedures to promote the protection and use of water, energy and food/land in a balanced manner, countering traditional silo thinking and divided responsibilities that often result in poorly coordinated investments, increased costs and underutilized infrastructure and facilities.

The Urban Nexus approach is an action-oriented guiding principle within the vision of a circular economy, where waste is viewed as a resource. Multi-sectoral and multilevel approaches which integrate resources contribute to improved resource efficiency. With many project cities identifying wastewater and solid waste management as their most pressing problems, the Urban Nexus approach emphasizes how wastewater and waste can be converted into sources of energy and useful by-products, such as fertilizer."

Source: UNESCAP, 2019
https://www.unescap.org/sites/default/files/Urban%20Nexus%20Publication_130519%20FINAL%20Edit.pdf

This policy brief provides suggestions and actionable measures for policymakers to adopt an urban nexus approach for integrating and strengthening efforts by cities as they strive to achieve national and global mitigation targets.

2. Energy and climate change scenario in the Asia-Pacific

The Asia-Pacific region[3] is the largest consumer of fossil fuels globally[4]. The region is expected to maintain its voracious appetite for carbon emission related activities in the coming years due to the upward trend in its consumption of natural gas, coal and oil. According to estimates from the International Energy Agency, total primary energy demand increased by 92 per cent, compared to the global average of 39 per cent, between 2007 and 2017. In contrast, primary energy demand dropped by two per cent and one per cent in North America and Europe, respectively, while growing in South and Central America by 49 per cent and in Africa by 69 per cent[4].

The increasing emissions from the Asia-Pacific region are alarming. The strong upward trend in fuel consumption in the Asia-Pacific region will lead to further increases in CO_2 emissions. Figure 1 showed that Asia region[5] alone share more than half of global CO_2 emission from fuel

[3] Geographical definition of Asia-Pacific region by IEA report may differ from UNESCAP's definition.
[4] https://www.oecd-ilibrary.org/docserver/weo-2018-en.pdf?expires=1562635035&id=id&accname=ocid196147&checksum=C3A2DD81289F3C52F979D073E1E038F6
[5] Asia region includes China, India, Japan, Korea, Middle East and Rest of Asia.

combustion. Asia's share of fuel combustion related CO_2 emission increased nearly three folds between 1990 and 2016, whereas share of Americas and Europe to fuel combustion related CO_2 emission decreased in the same timeframe.

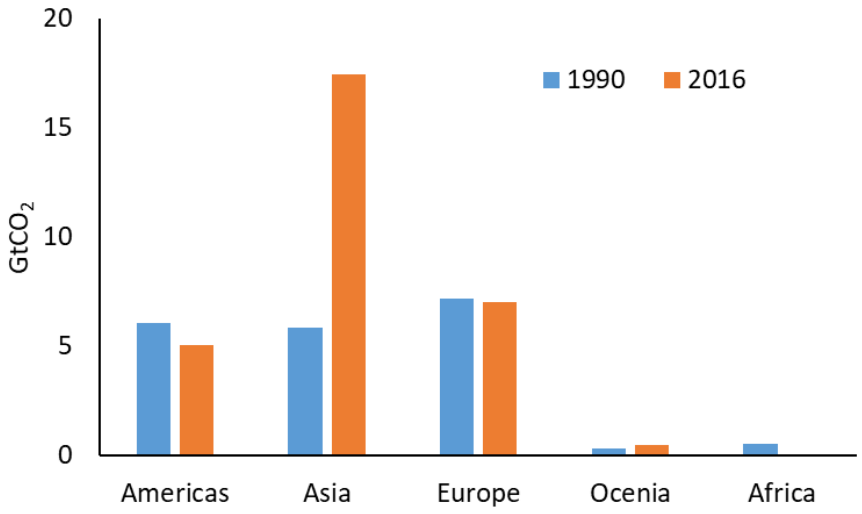

Figure 1: Regional share of CO_2 emissions from fuel combustion[6]

3. Responses to climate change mitigation in the region: Major policy measures

The Paris Agreement marked a turning point for many countries to strengthen their commitments to achieve ambitious cuts in CO_2 emissions. A total of 45 Asia-Pacific countries submitted their first NDCs with specific emission reduction commitments. Countries such as India and Indonesia updated their existing emission reduction targets to convey a strong commitment to the globally agreed 1.5°C/2°C targets. India increased its emission reduction targets from 20–25 per cent by 2020 to 33–35 per cent by 2030, and Indonesia from an unconditional 26 per cent by 2020 to 29 per cent by 2030. Other countries, such as Viet Nam and Mongolia, set emission reduction targets for the first time, with an 8 per cent GHG emission reduction target by 2030 and 14 per cent reduction in CO_2 emissions, respectively (Table 1). To achieve their national commitments, countries have introduced a set of policy measures both on the energy supply and demand sides. Energy supply side measures include increasing the share of renewable energy and minimising distribution loss, and on the demand side include enhancing energy use efficiency in buildings and industry. To support national emission reduction targets, many city governments have developed local level, low-carbon development policies. For example, Jaipur city in India has set a target of a 15 per cent share of solar energy in its total energy mix by 2020[7], and Ho Chi

[6] https://www.iea.org/statistics/co2emissions/
[7] https://data.cdp.net/Mitigation-Actions/2017-Cities-Community-wide-Emissions-Reduction-Act/ip4t-z8cm

Minh City, Viet Nam's economic hub, has established a target to increase its share of renewable energy by 1.74 per cent of the city's total energy consumption[8].

Table 1: Selected emission reduction plans in developing Asia

Country	NDC (2030 targets)	GHG mitigation measures
India	Reduction in CO_2 emissions intensity of gross domestic product (GDP) by 33–35% below 2005 levels by 2030	i. Increase share of renewable energy ii. Use of advanced power generation technologies iii. Reduce transmission and distribution loss iv. Energy conservation building code and building energy rating system v. Market-based energy efficiency trading mechanism for industries vi. Standard and labelling to inform consumers about energy consumption of appliances
Indonesia	Unconditional 29% reduction below business as usual (BAU) by 2030	i. Increase share of renewable energy to 19.7% ii. Use advanced power generation technologies iii. Improve energy use efficiency iv. Implementation of biofuel and compressed natural gas in transport sector v. Recovery of landfill gas and reuse of waste vi. Forest management
Mongolia	14% emission reduction by 2030, excluding land use, land-use change and forestry (LULUCF)	i. Increase renewable electricity capacity from 7.62% in 2014 to 30% by 2030 of total electricity generation capacity ii. Reduce electricity transmission losses from 13.7% in 2014 to 7.8% by 2030. iii. Reduce building heat loss by 40% by 2030 compared to 2014 level iv. Use advance energy generation technology v. Increase share of hybrid vehicles to 13% by 2030
Viet Nam	With domestic resources, by 2030 reduce GHG emissions by 8% compared to BAU in 2010	i. Increase of renewable energy generation capacity ii. Increase energy efficiency iii. Standard and labelling to inform consumers about energy consumption of appliances iv. Strengthen solid waste and wastewater management

Source: Compiled from first NDCs[9]

[8] http://www.aseanenergy.org/blog/energy-insight/how-does-renewable-power-generation-capacity-contribute-to-aseans-grid-interconnection-during-the-first-quarter-of-2019/

[9] https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx

4. Impact of cities of the Asia Pacific region on climate change and potential mitigation through urban nexus approach

As cities are home to more than half of the global population and most economic activity takes place in urban areas, the impact of cities on climate change is immense. The top 10 CO_2 emitting cities contribute 1,865 million tons of CO_2[10], which is more than the national energy related emissions of almost all countries, except the top three emitting countries China (9,430 Mt CO_{2e}), United States of America (5,495Mt CO_{2e}), and India (2,027 Mt CO_{2e}) in 2017[11]. Of the top 10 GHG emitting cities, five are found in the Asia-Pacific region – Seoul, Guangzhou, Shanghai, Singapore and Yokohama[10]. As Asia-Pacific cities account for a major share of global GHG emissions, this creates opportunities for them to take a leading role in mitigation.

An urban nexus approach assists city governments in identifying and implementing resource-efficient, low carbon and cost-effective interventions that can contribute to GHG mitigation targets as well as make the cities climate resilient regarding water supply, sanitation and energy systems. The urban nexus approach can be a guide for stakeholders to identify and understand interrelations among urban sectors and act to capture synergies. To translate the urban nexus concept into action, the German International Agency for Cooperation (GIZ) and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) jointly supported urban nexus projects in 12 cities in in 7 countries of the Asia-Pacific region – namely Chiang Mai and Korat in Thailand, Danang in Viet Nam, Naga and Santa Rosa in Philippines, Nagpur and Rajkot in India, Pekanbaru and Tanjungpinang in Indonesia, Rizhao and Weifeng/Binhai in China and, Ulaanbaatar in Mongolia. Urban nexus projects implemented jointly by UNESCAP, GIZ and the Local Governments for Sustainability (ICLEI) reveal that an urban nexus approach can strengthen local mitigation actions by increasing renewable energy generation capacity, improving energy use efficiency at the end consumer stage, and improving waste management. They can moreover capacitate and prepare cities to become more resilient towards climate change through implementation of solutions such as flood-proof sanitation systems, and robust and affordable housing technologies resistant to typhoons and earthquakes. All of these have been identified as important measures for national commitments to the 1.5°C/2°C global climate targets.

5. Illustrative cases: How the urban nexus approach can strengthen climate actions by cities

An integrated approach is required to achieve mitigation and adaptation targets simultaneously. Adopting the urban nexus approach is an entry point to break the barriers between actors and sectors and enhance collective actions. While implementation of national climate actions in developing countries faces challenges including a lack of resources, the following case studies illustrate that the urban nexus approach can overcome the challenges by introducing resource efficient, cost effective innovations and contribute to climate actions.

[10] https://doi.org/10.1088%2F1748-9326%2Faac72a
[11] https://www.wri.org/blog/2017/04/interactive-chart-explains-worlds-top-10-emitters-and-how-theyve-changed

Case 1: Capturing energy and reuse of treated domestic wastewater by introducing vacuum wastewater collection system in Da Nang City, Viet Nam

Background: Da Nang City is one of the fastest growing cities in Viet Nam, with a current population of more than one million. The city has experienced stable, continued economic growth, mainly driven by rapid increases in the tourism and service sectors. In 2015, it had over 4.5 million visitors, and numbers are expected to continue rising in the coming years. Da Nang's continued growth and expansion, however, has increased pressures on its urban infrastructure, including water and energy services, wastewater treatment, and caused environmental harm. As a coastal city, Da Nang also faces disaster risks associated with sea level rise, floods and typhoons.

In particular, access to adequate sanitation services has become a major challenge, with most households using septic tanks to dispose of wastewater. The wastewater collection system is inadequate, and this increases environmental risks including groundwater pollution and methane emissions. The ecological performance of septic tanks is also sometimes questionable, and the city could make better use of opportunities to turn wastewater into a resource.

Nexus Solutions: GIZ implemented a nexus project in collaboration with the Department of Planning and Investment (DPI). This project aimed to introduce an innovative wastewater management system to the city that can improve wastewater management as well as capture biogas to produce energy and supply fertilizer for agriculture. The Da Nang People's Committee (DPC) established a Nexus Task Force to ensure institutional coordination. A feasibility study was conducted, which proposed a flood proof vacuum sewer collection system to directly collect both black and grey water as well as capture biogas for energy generation. By-products such as processed sludge could then be used as fertilizer and the treated grey water could be used for urban agriculture irrigation. A technical design was elaborated to install the vacuum sewer system and connect 110 households at an estimated cost of 416,500 Euro. DPC expressed interest in the concept and agreed to implement the vacuum sewer system throughout the My An to My Khe area, covering 12,000 households with support of the World Bank[12].

Benefits: Implementation of this innovative wastewater management system contributes to national and local climate actions while increasing the resilience of Da Nang towards flooding risks. For climate change mitigation it helps by capturing methane and generating renewable energy. It also contributes to improve adaptation capacity by supplying treated wastewater for irrigation and processed sludge for urban agriculture. Overall benefits of introducing the vacuum wastewater collection system in Da Nang City are as follows:

Performance parameters	Anticipated benefits	Relevant goals/targets
Greenhouse gas mitigation	Capture methane from wastewater	NDCs, SDG-11, SDG-13

[12] GIZ. 2017. Case Study: Innovative Wastewater Management, Danang, Vietnam. https://www.unescap.org/sites/default/files/CaseStudy_VN_Danang_WastewaterManagement_2017_0.pdf

Renewable energy generation	Energy generation from captured methane	NDCs, SDG-7, SDG-11, SDG-13
Use of by-products	Use of treated wastewater for irrigation and processed sludge for urban agriculture	SDG-2, SDG-6, and SDG-11
Awareness raising on urban nexus solutions	Increased	SDG-2, SDG-6, SDG-7 and SDG-1, SDG-12
Cross sectoral interactions	Increased	SDG-11
Cost performance	Improved	SDG-11

Case 2: GHG mitigation from energy-saving technologies in wastewater treatment facilities in the rubber industry, Palembang City, Indonesia

Background: Indonesia was the fourth largest emitter of GHGs (including land use change and forestry) globally in 2014 [13] . After the Paris Agreement, the country strengthened its commitments to reducing global warming in their NDC. It set an unconditional target to reduce CO_2 emissions by 29 per cent by 2030, and with international support, to 41 per cent[14]. In their NDC, Indonesia identified enhancement of energy improvement as a priority area, and as cities are home to over half of the country's population and most economic activity is concentrated in urban areas, this revealed many energy-saving opportunities. Under Government Regulation No 70/2009, private and industrial sectors have been allotted major responsibilities in the field of energy conservation, and industry is one of the targeted sectors for enhancing energy efficiency through adopting appropriate technologies. Related to this, the government has implemented a set of incentives on energy conservation, including tax exemptions for energy-saving appliances, import tax reductions for energy-saving products, and low interest financing for energy conservation.

Nexus Solutions: The project aimed to improve the performance of wastewater treatment facilities of a rubber company, PT. Aneka Bumi Pratama, located in Palembang City. As a result of the project, the company is now able to meet Indonesia's effluent-wastewater quality standards. Aerator technology is to be installed to improve the wastewater treatment facilities of the rubber company, which will accelerate mixing of air from the blower to reduce methane emissions. Since there is no pressure loss at the blower, this can reduce the energy consumption of wastewater treatment facilities. The aerator requires minimal maintenance to operate.

Benefits: By increasing energy efficiency and avoiding methane emissions, aerator technology can directly contribute to national and local climate actions. It also helps mitigate water pollution, which can contribute to adaption capacity in water management of Palembang City. Overall projected benefits of this project are:

[13] https://www.climatewatchdata.org/ghg-emissions

[14] Government of Indonesia. 2016. First Nationally Determine Contribution. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Indonesia%20First/First%20NDC%20Indonesia_submitted%20to%20UNFCCC%20Set_November%20%202016.pdf

Performance parameters	Anticipated benefits	Relevant SDGs
GHG mitigation	Estimated CO_2 mitigation of 745 tons/year through energy savings. CH_4 emissions will be reduced through stimulated aerobic process[15]	SDG-11, SDG-13
Energy efficiency improvement	Estimated reduced energy consumption of 931 MWh	SDG-7, SDG-11
Effluent quality	Meets effluent standard of Indonesia	SDG-6, SDG-11, SDG 13

Case 3: Installation of solar power systems at agricultural farms for power supply in Ulaanbaatar, Mongolia

Background: Ulaanbaatar, the capital city of Mongolia, is home to over half of the country's population. In average 19,000 persons per year migrated to the capital city between 2000 and 2017[16]. Although the Government of Mongolia put a ban on migration into the capital city, number of unregistered migrants may continuously increase, which is mostly driven by unequal economic and social development[16]. As a result, demand for basic services and infrastructure development will continuously increase. Mongolia's energy sector relies on coal-based power plants for more than 96% of its energy supply, and this high fossil fuel dependency leads to large amounts of CO_2 emissions from the energy sector.

Nexus Solutions: Mongolia has set a target of generating 20 per cent of total energy from renewable energy sources and aims to reduce its dependency on high CO_2 emitting coal-based power generation[17]. The solution involved a wholesale distributor, Everyday International LLC, which initiated a solar power generation project, which was registered by the government through the bilateral cooperation under the Joint Crediting Mechanism (JCM) as a mitigation project. The project aimed to improve power supply in the city and contributes to CO_2 mitigation by installing solar power systems at agricultural farms in the suburbs of Ulaanbaatar (Figure 2). These power plants can generate 3,352 MWh of electricity, which translates as a significant reduction in reliance on coal-fired thermal power, and thus avoidance of CO_2 emissions. Moreover, the solar power system also helps improve food supply by capturing synergies between agricultural and solar power generation technology.

[15] http://gec.jp/jcm/projects/15ps_ina_01/
[16] https://reliefweb.int/sites/reliefweb.int/files/resources/mongolia_internal_migration_study.pdf
[17] https://www.greenclimate.fund/documents/20182/1688867/Mongolia_Country_Programme.pdf/da4b9c33-75ce-3ed7-69bf-7cdadd84697e

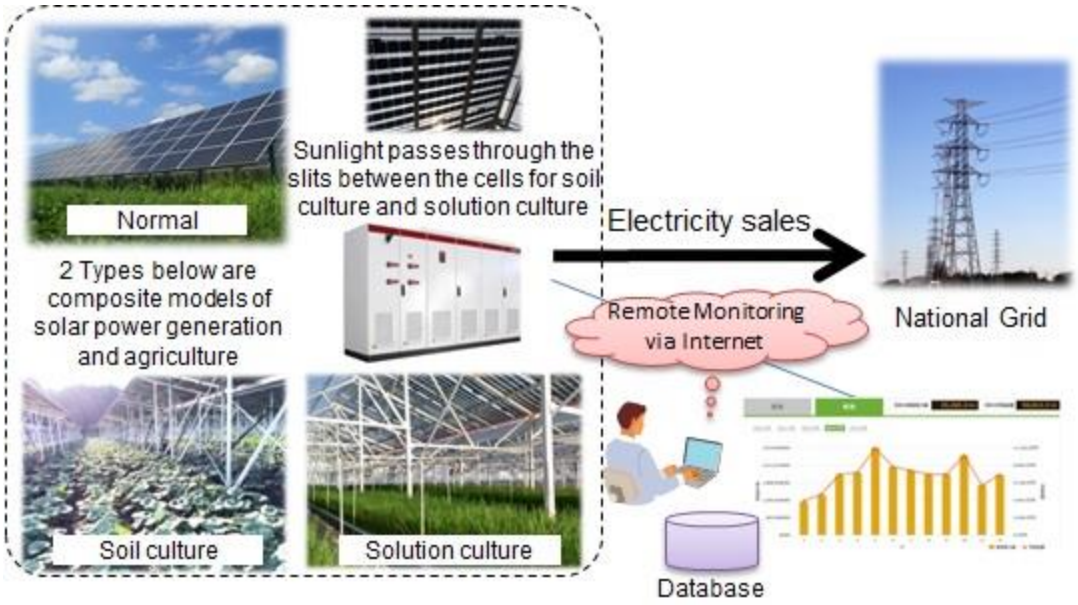

Figure 2: Nexus interventions through installation of solar power generation system at agricultural farms in the suburbs of Ulaanbaatar[18]

Benefits: This project contributes to the NDCs as well as SDGs by generating the following multiple benefits:

Performance parameters	Anticipated benefits	Relevant SDGs
CO2 mitigation	2,682 tons CO_2/year	NDCs, SDG-11, SDG-13
Renewable energy supply	3,352 MWh/Year (estimated)	SDG-7, SDG-11
Agriculture production	Improved	SDG-2

6. Challenges to operationalise urban nexus approach for NDCs

The major challenges facing operationalisation of the urban nexus are discussed in the policy brief on "Applying urban nexus approach as means of implementing sustainable development goals (SDGs)". In addition, operationalisation of the urban nexus approach for NDCs faces the following challenges:

i. **Mismatch between national mitigation targets and local priorities and actions.** Generally, a conventional top-down approach is applied to set national climate targets and actions, ignoring local interests and priorities, potential mitigation areas in local contexts, and institutional, technical and financial capacities of local governments and other key actors.
ii. **Lack of knowledge of urban nexus solutions/innovative technologies that simultaneously contribute to GHGs mitigation and enhanced adaptive capacity.** While

[18] http://gec.jp/jcm/projects/15pro_mgl_02/

project designers and engineers can act as a channel to promote urban nexus solutions, they lack knowledge on technologies that can generate these solutions.

iii. **Lack of simple yet robust methodologies and data to measure emissions reductions.** To quantify the GHG mitigation and adaptation benefits of urban nexus projects, practical and robust accounting tools are required. Some tools are available that can measure only GHG mitigation; however, many are too complex technically for local experts and some of the required baseline data may not be available.

iv. **Lack of standard monitoring, reporting and verification (MRV) frameworks.** Accounting regarding contributions of urban nexus projects for monitoring NDCs requires standard monitoring and reporting processes be followed to avoid double counting, over- or under-estimation, and other accounting problems. Project implementers generally do not follow standard monitoring and reporting processes, and there are no incentive mechanisms for them to do so.

7. Policy recommendations

The following recommendations are given to assist countries in designing sets of coherent policy interventions to implement urban nexus projects to achieve their NDCs:

i. **Strengthening coordination and communication between national and local governments:** Local governments can be encouraged or mandated to develop their own climate actions and identify potential areas of implementation for the urban nexus. Local climate actions can then be used as inputs to national commitments.

ii. **Providing capacity building and training to local project planners and engineers:** Local project planners and engineers are key actors in selecting technological solutions. Their capacities can be boosted to ensure they understand what technologies provide nexus solutions and how these can be effectively implemented.

iii. **Developing practically applicable methodologies and tools for accounting and tracking contribution of urban nexus projects in mitigation and adaptation and MRV frameworks at the city level:** Development of tools for accounting mitigation and adaptation contributions and MRV frameworks is necessary to evaluate the contribution of potential nexus projects to climate actions. Easily applicable and credible methodologies, tools and MRV systems can be developed by using simple yet robust calculation methods, minimising the number of parameters to be monitored, and making full use of existing data.

The content of this paper was prepared by Bijon Kumer Mitra, Ngoc-Bao Pham, Kentaro Takahashi and Henry Scheyvens, Institute for Global Environmental Strategies (IGES) under full supervision of Mr. Kyungkoo (Philip) Kang, ESCAP. This paper benefited from comments by Curt Garrigan (ESCAP), Ruth Erlbeck (GIZ), Omar Siddique, Alexander Vougioukas (ESCAP) and Dr. Shobhakar Dhakal (IPCC 6th Assessment Report author). **For more information about the Urban Nexus project, visit: https://www.unescap.org/urban-nexus**