Korea and the World Economy, Vol. 18, No. S1 (February 2017) 25-45

# Climate Change Actions in Asia and the Pacific: Forging a Low-carbon Development Path*

Sangmin Nam** · Gabrielle Chan***

As home to two-third of the global poor, many countries in Asia and the Pacific face two inextricably linked challenges — overcoming poverty and combating climate change. Failure to tackle one will undermine progress of the other. In this connection, this paper reviews both development and climate challenges in the region, and presents low carbon development pathways and specific policy options on energy, urban infrastructure, food security, natural capital, etc., to strive for overall sustainability including climate resilience. The paper also identifies a number of approaches to pursue low-carbon development paths more cost-effectively.

JEL Classification: Q01, O13, O44
Keywords: climate change, low carbon development path, sustainable development, greenhouse gas, Asia-Pacific

* Received December 12, 2016. Revised January 31, 2017. Accepted February 11, 2017. The views expressed herein are those of the authors and do not necessarily reflect the views of the United Nations.
** First author, East and North-East Asia Office, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Tel: +82-32-458-6603, E-mail: nams@un.org
*** Second author, East and North-East Asia Office, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), Tel: +82-32-458-6600, E-mail: gabrielleks.chan@gmail.com

# 1. INTRODUCTION

Asia and the Pacific, home to 4.3 billion people, is the global epicenter of both development and climate challenges. The region shares about 54% of global greenhouse gases emissions in 2013 and is home to 5 out of 10 top greenhouse gas (GHG) emitters in the world (WRI, 2017). The region's share of GHGs continues to increase due to the current trend of industrialization and urbanization, both of which are high in energy and carbon intensity. Furthermore, with about 40% of the Asia-Pacific population being "living poor" (ESCAP, 2015), the region does not only face huge challenges in meeting its development needs, its challenges are also exaggerated by increasing climate variability and extreme weather events. Many least developed countries are particularly vulnerable to climate change as livelihood of the majority of rural poor is climate-sensitive such as through rain-fed subsistence farming. The region is also prone to climate-related extreme events, with 9 out of 10 countries in the world at the highest mortality risk from flooding are in the region and it also has more than 90% of the global population exposed to tropical cyclone (IPCC, 2014). Worse still, it is often the poor that are disproportionately threatened with their climate-sensitive livelihoods and exposure to locations at the highest risk of extreme weather events.

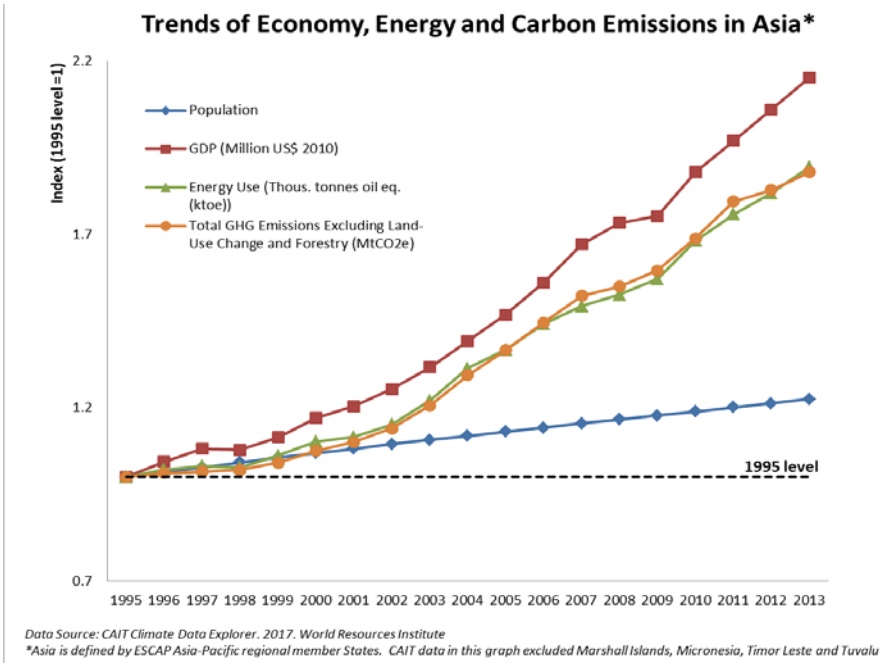
Despite the significant needs to reduce GHG emissions from the energy sector, the region still has huge unmet gaps in energy demand and supply. About half a billion people are without access to electricity in developing Asian countries, which poses a dilemma in addressing both development and climate change concerns (IEA, 2015). Thus, a key challenge for the region is to identify and promote strategies that can simultaneously address both climate and development challenges through, for example, inclusive and low carbon development pathways. This is also emphasized in the Paris Agreement which calls for all Parties to formulate "long-term low greenhouse gas emission development strategies" by 2020 in addition to the regular update of nationally determined contributions every five years (UNFCCC, 2015).

In this regard, this paper attempts to analyze the regional context of climate change and development challenges, and proposes a number of approaches and policy measures for inclusive and low carbon development pathways.

## 2. SOCIO-ECONOMIC CONTEXT OF CLIMATE CHANGE IN ASIA AND THE PACIFIC

There are a number of key development challenges that have to be taken into account when developing policies and measures to address climate change. Firstly, the Asia-Pacific region has increasing demand for energy supply in connection with the growth of manufacturing-based economy and the rapid expansion of energy-intensive lifestyle. The region is set to dominate

**Figure 1 Economy, Energy and Greenhouse Gases Emissions in Asia-Pacific**




Source: Climate Analysis Indicators Tool (CAIT), 2. 2014 (available at: http://cait2.wri.org).

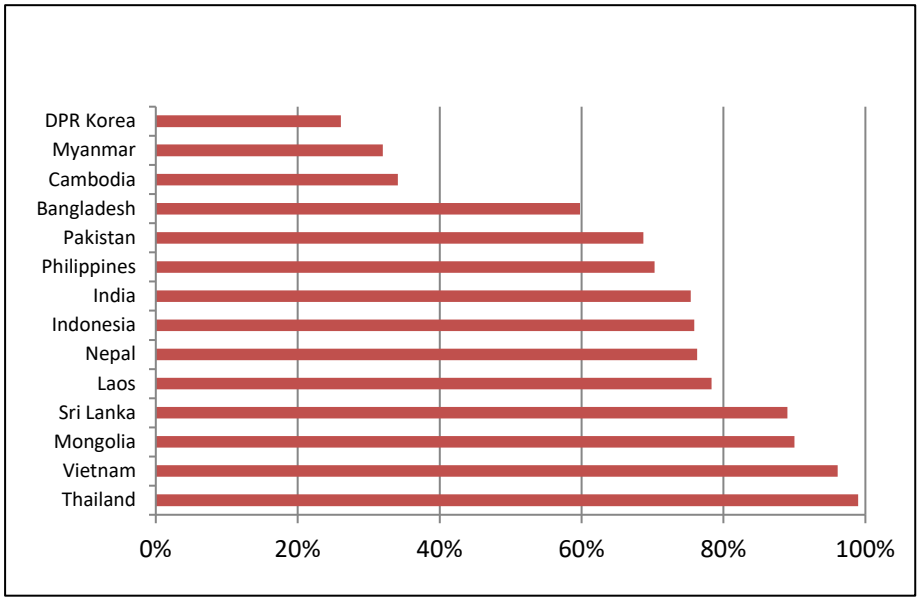
global demand for energy due to its strong projected GDP growth rates, large population, and relatively low per capita energy use base.

According to the ADB (2013), energy demand in the region is projected to increase by about 80% between 2010 and 2035 at an annual rate of 2.1%, which is faster than the world average growth rate of 1.5%. The region is also the world's largest coal consumer, accounting for 77% of the world's consumption in 2015 (BP, 2016). Meanwhile, carbon intensity (kg of $CO_2$ per thousand USD GDP) of Asian countries is significantly higher than the world average (0.67 versus 0.44), with big gaps between developed countries such as Republic of Korea (0.46) and Japan (0.21), and developing countries such as China (1.10), Kazakhstan (1.21), India (0.92) and Mongolia (1.59) in 2014 (IEA, 2016). The current heavy reliance on fossil fuel is not only contributing to the upward trend of $CO_2$ emissions, it also increases the region's vulnerability to volatile fuel and energy prices, unstable energy supply and poor air quality with its associated health effects.

Secondly, the Asia-Pacific region faces rapid urbanization with an annual growth of 2.6% since 1990. It is the second highest urban population growth rate in the world after Africa (ESCAP, 2014). While existing infrastructure development and growth patterns have locked cities in energy- and carbon-intensive pathways, the current urbanization rate creates needs for rapid expansion of urban infrastructure. As investments in urban infrastructure underpin economic growth and determine patterns of energy use and GHG emissions for decades to come, the management of urbanization and urban infrastructure will be key to address both development and climate challenges.

Thirdly, the huge unmet basic energy needs is a critical issue in Asia and the Pacific. Access to basic energy services is essential for sustainable development and poverty eradication. Significant improvements have been made over the years yet 526 million people in developing Asia still have no access to electricity (IEA, 2015). Figure 2 illustrates the non-uniformity in access to modern energy supplies within Asian countries in terms of the size of national population not connected to the grid. Considerable increase in electricity generation and infrastructure are needed to connect this large

**Figure 2 Access to Electricity in Selected Asian Countries (in 2013)**




Source: IEA (2015), "World Energy Outlook".

population with electricity and the choice of energy source will have majorimpact in the subsequent GHG emission trend.

Fourthly, apart from energy needs, the region still has to mitigate climate impact on agriculture whilst increasing its agricultural productivity to feed more than two-third of world's undernourished people (ESCAP, 2014). The impact of climate change on food production varies within the Asia-Pacific region as pointed out in the Intergovernmental Panel on Climate Change's Fifth Assessment Report (IPCC AR5) due to the scale and direction of changes in the length of growing season and the rate of photosynthesis (related to concentration of $CO_2$). While crop yield is likely to increase in areas such as northern and eastern Kazakhstan, it is expected to decrease in other areas such as the Indo-Gangetic Plain of South Asia. Moreover, the agriculture sector shared approximately 10% of the global GHG emissions in 2011, of which Asia accounted for 44% of this portion (FAO, 2014). Increase in food production to reduce the undernourished population, to feed its growing

population, as well as to serve the wealthier population will pose additional pressure in controlling its subsequent emissions.

Fifthly, there is an upward trend of frequency and intensity of extreme weather events that further deteriorates the socioeconomic conditions of developing countries and threatens livelihoods of the poor. Six out of ten countries most affected in the Long-Term Climate Risk Index (CRI) during 1995-2014 are found in Asia (German Watch, 2016). Myanmar alone has the highest annual average death toll in the world of over 7000 deaths during 1993-2012. More people in Asia are living in cyclone-prone areas and 90% of the world's population exposed to tropical cyclones live in the region (IPCC, 2014). These climate change "hot spot" areas such as low-lying coastal areas, small island states and semi-arid or low-humidity regions are at higher risk of adverse impact from climate change. Thus, compounded by the high exposure and large amount of poor population in the region, climate change has significant and multi-faceted implications on human security.

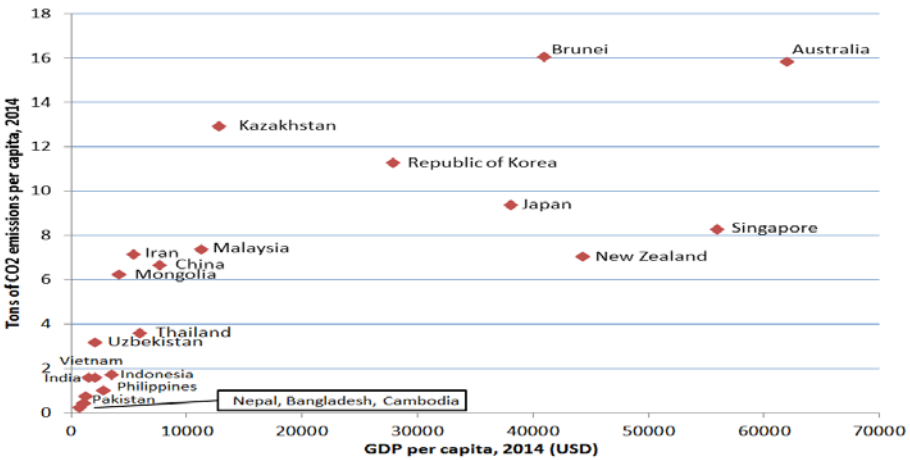
Finally, developing countries in Asia and the Pacific are suffering from the lack of resources for prevention, adaptation, and mitigation of climate risks. As pointed out in the IPCC AR5, underlying determinants of mitigative and adaptive capacities are often linked under the umbrella of sustainable development, such as infrastructure, governance, health services, etc. The poor are often most vulnerable and lack essential adaptive capacities to be climate resilient. The vulnerability of countries and population groups to climate change depends on the combinations of both natural and socioeconomic factors such as the magnitude of and socioeconomic sensitivity to climate change, as well as their coping and adaptive capacity (Welt-sichten, 2008). The IPCC AR5 highlights that there are groups that face multiple burdens as they are exposed to overlapping risks from socioeconomic changes, biophysical degradation and climate change impacts (IPCC, 2014). Bangladesh, for instance, remains at very high risk not only due to its geographic exposure to the biophysical impact of climate, but also for its very young and poor population that depends primarily on subsistence agriculture.

# 3. AN INCLUSIVE AND LOW CARBON DEVELOPMENT PATH

Considering both development and climate change challenges, there is urgent need to identify low-carbon development paths (LCDP) that are not "slower" development but instead, provide multiple benefits to both climate change mitigation and development at global and local scale. Low carbon development has been increasingly recognized by academics and practitioners as a practical strategy that supports middle and high income countries to promote low carbon innovation, and for low and middle income countries to have better access to modern energy and low carbon technology to meet development needs (Urban and Nordensvärd, 2013).

LCDP can be taken in various forms as countries have considerably different development paths in terms of carbon emission per capita and GDP per capita, as shown in Figure 3. However, the general approach is to harmonize economic growth and mitigation of GHG emissions through promoting policy and technical measures. For instance, such measures can be widening access

**Figure 3 Different Development Paths in terms of $CO_2$ Emissions and GDP**



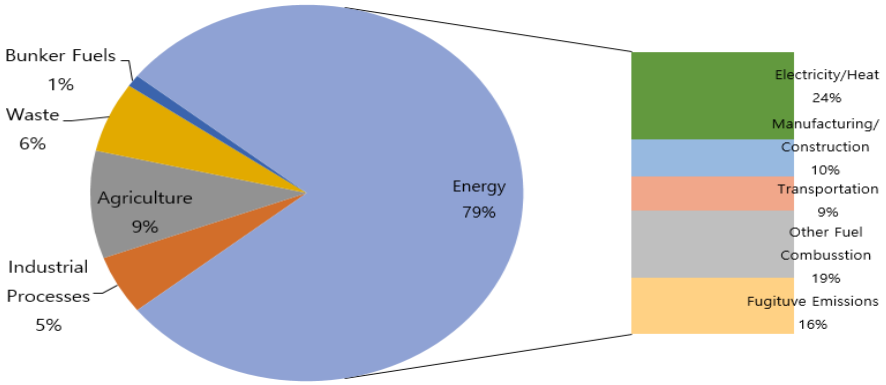

Sources: 1) World Bank (2011b). 2) World Bank (2011a).

to basic needs such as energy and water, enhancing energy security, promoting eco-efficient infrastructure development, building inclusive and sustainable cities, improving economic livelihood of urban and rural communities, and attaining Sustainable Development Goals (SDGs). To achieve multiple outcomes, LCDP cannot be a stand-alone strategy, it has to be an underpinning part of the national sustainable development plan. In addition, linking low-carbon development actions with SDGs enables better and more comprehensive integration of LCDP in the development context, allowing benefits and risks in various aspects be identified and addressed. In this regard, this section proposes overriding policy measures to address multiple and intertwined challenges confronting developing countries.

### 3.1. Improving Energy Efficiency

Considering the dominant role of the energy sector in GHG emissions, as shown in Figure 4 and Table 1, one of the most cost-effective low-carbon development actions is to improve the efficiency of how energy is generated, transported and used. The IEA's Bridge Scenario which identifies policy scenarios for peaking global GHG emissions by 2020 and putting the world on track, indicates that the largest contribution to global GHG abatement comes from energy efficiency, accounting for 49% of the savings in 2030 (IEA, 2015). Government policies including fiscal incentives, credit support and price instruments are essential to motivate the improvement of energy efficiency. For example, providing tax incentives for investments in newer and cleaner technologies for electricity generation, fuel combustion, manufacturing and construction can result in huge amount of energy savings. In addition, these policy tools can enhance the energy-efficiency market. Driven by the 16% energy-intensity reduction target under the 12$^{th}$ Five Year Plan, China's energy-efficiency market surpassed 100 billion USD in 2010 (IEA, 2014). By 2015, China has exceeded the target by reaching 18.4% reduction of its energy intensity and set further targets in the 13$^{th}$ Five Year Plan to 18% reduction against its 2015 level by 2020 (NDRC, 2016). Under

**Figure 4 Greenhouse Gas Emissions by Sector in Asia, 2013**




Source: CAIT Climate Data Explorer (2017).

**Table 1 GHG Emissions by Sector in Major Emitting Countries in 2013**

(unit: %)

| | China | India | Indonesia | Japan | Republic of Korea | Russian Federation |
|---|---|---|---|---|---|---|
| Energy | 78.8 | 70.6 | 68.3 | 91.8 | 87.2 | 89.8 |
| • Electricity & Heat | 40.1 | 36.9 | 24.1 | 45.3 | 49.5 | 42.9 |
| • Manufacturing & Construction | 23.2 | 15.7 | 12.4 | 17.8 | 14.7 | 12.6 |
| • Transportation | 6.4 | 7.2 | 16.9 | 16.0 | 12.7 | 10.1 |
| • Other Fuel Combustion | 6.3 | 9.5 | 8.6 | 12.4 | 9.0 | 6.2 |
| • Fugitive Emissions | 2.8 | 1.3 | 6.3 | 0.2 | 1.3 | 18.0 |
| Industrial Processes | 11.8 | 5.6 | 1.9 | 6.1 | 9.2 | 3.0 |
| Agriculture | 7.6 | 21.9 | 21.5 | 1.8 | 2.0 | 4.0 |
| Waste | 1.8 | 2.0 | 8.4 | 0.3 | 1.6 | 3.1 |
| Total ($MtCO_2e$) | 10,975.5 | 3,013.8 | 760.8 | 1,344.6 | 693.3 | 2,322.2 |

Source: CAIT Climate Data Explorer (2017).

the “Made in China 2025” plan, China also aims to achieve reduction of energy intensity in the manufacturing sector by 34% compared to 2015, and reduction of $CO_2$ emissions per unit of industrial added value by 40% by 2025 compared to 2015 levels.

The increase of energy efficiency and the development of renewable energy are powerful in enhancing national energy security. Most small island developing countries in Asia and the Pacific depend entirely on imported fossil fuels. In particular, fossil fuels account for almost all energy use, with the exception of small-scale burning of biomass for cooking and waste disposal (Dornan, 2015). The increase in investment on energy efficiency and renewable energy can dramatically lower their dependence on fossil fuels imports, reducing risks and strengthening energy security.

Low-carbon development actions can also help businesses to stay competitive in energy performance, cost reduction, retain existing jobs and create new ones. The global market volume for environmental products and services reached USD 1.05 trillion in 2015, grew by 47% during the last 10 years (US ITA, 2016). A growing number of companies have also announced ambitious goals to reduce their carbon footprints or to turn their operations carbon neutral.

### 3.2. Increasing Accessibility of Electricity through Renewable Energy

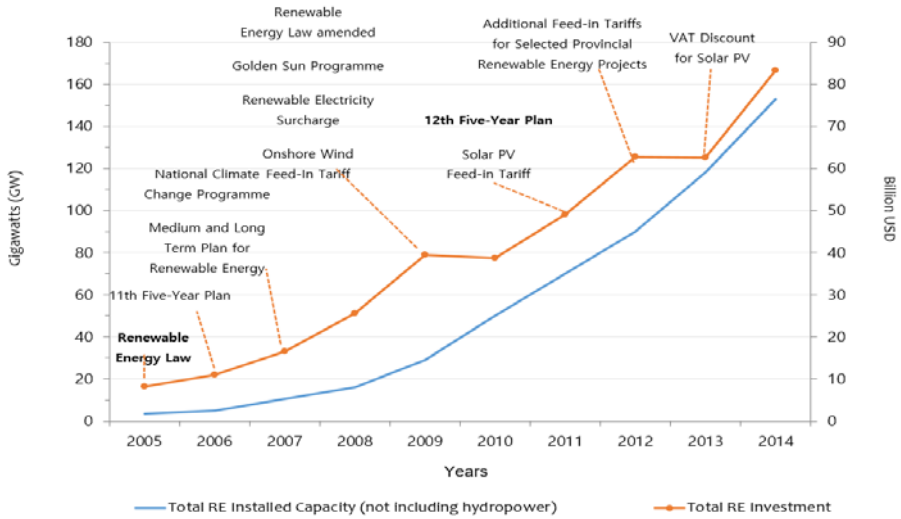
While two thirds of the world relies on fossil fuels and are “high energy users”, almost two billion people in the world are “low energy users”, relying primarily on biomass-based fuel to meet their energy needs. In Asia and the Pacific, more than half a billion people do not have access to electricity, with a considerable rural-urban divide. Low-carbon energy generation often encompasses off-grid renewable energy source such as solar, wind, and small hydros. It is therefore an ideal solution in closing this gap while minimizing emissions from generating electricity.

The increase in the use of renewable energy is a convincing approach to supplement and replace existing fossil fuel use which is also the biggest source

of GHG emissions. In addition, the expansion of renewable and alternative energy supply offers other important advantages: reducing transmission costs and losses, and enhancing accessibility to basic energy services for sparsely located rural households; as a practically inexhaustible resource base; and zero recurring import requirements.

The expansion of renewable energy also requires supporting policy measures. Developing countries have increased the adoption of renewable energy targets and supporting policies worldwide. Among these policies, Feed-in Tariffs (FIT) and Renewable Portfolio Standards (RPS) are the most common, adopted by 19 Asian countries in 2014 (Ren21, 2015). China has shown that developing countries can use this strategic opportunity to leapfrog the existing carbon-intensive industrialization. Its rapid growth in renewable energy generation is contributed by a number of supporting policies highlighted in the Figure 5. Strong national initiatives and vigorous responses of industries have rapidly increased the scale of renewable energy and its share

**Figure 5 China's Renewable Energy Development, 2005-2014**




Sources: 1) Bloomberg New Energy Finance (BNEP) and United Nations Environment Programme (UNEP) (2015). 2) Ren21 (2015). 3) International Energy Agency (IEA), *IEA/IRENA Joint Policies and Measures Database* (available at: http://www.iea.org/policiesandmeasures/renewableenergy/?country=China).

in global renewables, e.g. 30% of world wind power with 114.6 GW in 2014 (GWEC, 2015).

### 3.3. Building Sustainable Urban Infrastructure

With rapid urbanization, the development of an eco-efficient urban infrastructure is becoming more important than ever in Asia and the Pacific. The transport sector alone accounts for 19% of total $CO_2$ emissions in top Asian emitters.[1)] Most countries in Asia and the Pacific are rapidly developing transport infrastructure, which will determine their emission patterns for decades to come. Provision of low emission and energy efficient public transport can significantly reduce GHG emissions by encouraging the use of public transport, reduce congestion and also provide further social benefits by improving equal access to mobility for all. A low-carbon urban design can also improve social conditions, health and access for the poor, including locating housing and business to reduce commuting times and costs, improving the conditions for walking and cycling, and improving public transport. In addition, greening building and industry infrastructure can reduce GHG emissions and energy costs for the poor. An assessment supported by the Stockholm Environment Institute found that mitigation actions in cities could generate annual GHG savings of 3.7Gt $CO_2$e in 2030 and 8.0 Gt $CO_2$e in 2050. These savings are around 15-20% of the total global emission reductions needed for a 2°C pathway by 2030.[2)] The largest 500 cities by population could contribute 1.65 Gt $CO_2$e by 2030, nearly half the identified urban mitigation potential (Erickson and Tempest, 2014).

The densely populated urban areas in Asia and the Pacific are also prone to natural disasters that can result in unprecedented human and financial costs. The region has 15 of the global top 20 cities for projected population exposure and 13 of the top 20 for asset exposure (IPCC, 2014). Worst still, vulnerable

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[1)] Top Asian $CO_2$ emitting countries include Australia, China, India, Indonesia, Iraq, Japan, Republic of Korea, Malaysia, Thailand and Vietnam (WRI, 2017).
[2)] UNEP (2015).

groups often have greater exposure to disasters and lack the resources and capacity to be resilient. Extreme weather events such as floods and typhoons are projected to become more frequent and intense, together with a rapidly growing urban population, urban infrastructure must also become more resilient.

As Asia and the Pacific continues to rapidly become more urban than ever before, new innovative policies for sustainable urban development will enable societies to strike balance between social equity, economic growth and environmental sustainability. In this connection, there is notable progress in policy initiatives for promoting low-carbon cities. This includes the low carbon pilot city programme of China,[3)] and the Low-Carbon City Promotion Act as well as the eco-model city programme of Japan, which encourage target cities to set up quantitative mitigation goals of GHG emissions.

### 3.4. Ensuring Food Security through Mitigation of Climate Change

GHG emissions from agriculture are mostly from four key sub-sectors: Nitrous dioxide from agriculture soils through the processes of nitrification and denitrification intensified by fertilizers; methane from enteric fermentation in ruminant livestock and both methane and nitrous dioxide from manure management; methane from anaerobic decomposition in rice cultivation; and carbon dioxide from the residue burning and forest clearing (FAO, 2014). As Figure 4 shows, the agriculture sector in Asia and the Pacific shares about 9% of total GHG emissions from the region. At the same time, this sector is the most venerable to climate change, thereby at highest risk of deteriorating the elements of food security, i.e., availability, stability, utilization, and access.

Current agricultural and industrial practices including land conversion from forested area to cultivated or grazing land, are one of the key emission sources

[3)] Low Carbon Pilot Cities (2010) is a nation-wide pilot projects, participated by 42 city and provincial administrations to formulate and implement comprehensive low carbon development plans. In 2014, the Low Carbon Pilot Communities (2014) initiative further expanded to community level and is expected to involve more than 1000 low carbon pilot communities across the country by the end of the 12th Five-Year Plan (2015).

of GHGs. Thus options of mitigating GHG emissions in agriculture have been developed, they include improved crop and grazing land management; restoration of organic soils that are drained for crop production and restoration of degraded land; improved water and rice management; set-asides, land use change and agro-forestry; and improved livestock and manure management.

Combination of mitigation actions can simultaneously promote adaptive capacity of the sector, such as adopting low emissions practice along with growing more adaptive crop species. The land use and agroforestry sector is one of the areas with the greatest potential benefits of integrating mitigation and adaptation actions, according to the IPCC Fifth Assessment Report (IPCC, 2014). Many mitigation opportunities require only currently available technologies and can be implemented immediately. Like other sectors, agricultural mitigation measures often have co-benefits of improved efficiency, reduced cost and environmental benefits, and in turn has significant synergy with the wider framework of sustainable development. Considering the significant contribution of agriculture to GHG emissions and the increasing demand for food to reduce malnourishment and for the growing population, mitigation actions will become more influential on GHG mitigation while simultaneously promote adaptive capacity of the sector as well. There is also growing global attention to strengthening soil carbon sequestration as key mitigation action in the agriculture sector.

Furthermore, it is also crucial to take an integrative approach to strengthen the natural foundation of agriculture such as water, land and ecosystem by sound natural resources management. Climate change impacts on agriculture are location-specific as they are directly associated with water resources, land management and ecosystem. While variations in regional and domestic meteorological dynamics can alter the fundamental condition of food production, local agro-ecosystems are still key determinants on the level of resilience against regional and domestic-level impacts. It is critical to strengthen water infrastructure buffering capacity as adaption to increased rainfall fluctuation and to enhance natural water storage capacity by sound management of agro-biodiversity and forests. In this regard, sustainable

management of forest which sustains biodiversity and as natural reservoir of water resources, will enhance resilience to climate change.

### 3.5. Protecting Natural Capital for Society and the Atmosphere

Three out of the world's top-ten countries with the largest net loss of forests between 1990 and 2005 are in the Asia-Pacific region: Indonesia, Myanmar and Australia. During this period, Indonesia is estimated to have lost over 250,000km$^2$, and Myanmar over 80,000km$^2$ (World Bank, 2015). Even though deforestation still persists within the Asia- Pacific region, some countries are making progress in reversing this trend. Land-use change in China, for example, transitioned from a net carbon emitter in 1995 to become a carbon sink in 2000 with the increase of forest coverage. China plans to further increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level under the Nationally Determined Contributions (NDCs). India also aims to increase its forest cover from 23% to 33%. The Indonesian government plans to reverse the current deforestation to contribute in attaining half of its GHG mitigation target by 2020. Conserving natural capital could increase the capacity to sequester carbon and is also influential in the adaptive capacity of many rural poor. Much of the rural population relies on subsistence livelihood which depends heavily on various ecosystem services. Deforestation and over-exploitation of land resources has contributed to wide-spread land degradation and disruption to ecosystem services. Protecting natural capital can therefore secure the natural, human and financial capital, and considerably enhance vulnerable groups' adaptive capacity to climate change and other shocks.

### 3.6. Reducing Black Carbon and Improving Human Health

As the world is now approaching numerous climate change tipping points, identifying and implementing the fastest and most cost-effective mitigation measures is of critical importance. Reducing the emissions of black carbon, which absorbs heat and reduces albedo of snow on glaciers, could provide a

solution for preempting future climate change. Black carbon is not a gas; it is composed of very small carbon particles found in soot, and produced from the incomplete combustion of fossil fuels, biomass and biofuels. Black carbon is extremely potent. Its radiative forcing is, by some recent estimates, almost twice as much as methane and as much as 55% of carbon dioxide (Ramanathan and Carmichael, 2008). Asia is the major source of black carbon emitting about 40% of the global emissions. Much of the black carbon produced in Asia and the Pacific derives from inefficient engines especially in small vehicles and diesel trucks; and from the burning of coal in in-home heating, forests, peatlands and crop residues, etc.

While black carbon emitted from Asia has impacts beyond the region, it also has direct consequences in regional hydrological and meteorological conditions as well as health of local communities. When black carbon accumulates on top of glaciers, it combines both of these effects — absorbing heat and reducing albedo — accelerates the melting of glaciers. Heavy atmospheric concentrations of black carbon over India and China threaten the Hindu-Kush-Himalaya-Tibetan glaciers, which are sources of major river systems in Asia. Despite continuous reductions of all major greenhouse gases should remain the cornerstone of any climate change stabilization strategy, mitigation of black carbon, which has a relatively low-cost with currently available technologies, could produce significant global cooling results in a very short span of time. This can be achieved through policies or practices which improve efficiency of combustion process; remove perverse subsidies from dirty fuels; subsidize engine and filter upgrades; switch to solar stoves or stoves that use gas from organic waste and reduce agricultural burning, etc.

## 4. CONCLUSION

As home to two third of the global poor, many countries in Asia and the Pacific face two inextricably linked challenges — overcoming poverty and combating climate change. Failure to tackle one will undermine efforts to deal

with the other. Asia-Pacific countries are already witnessing the threats of climate change through increased temperatures and frequency and intensity of climatic events (e.g., tropical cyclones, floods and droughts). It is estimated that impacts of climate change are likely to intensify in the near and later future, compounding the already pressing problems of resource scarcity. Failing to incorporate climate change mitigation and adaptation considerations into development policy will undermine future economic growth, the continued improvement of the Sustainable Development Goals (SDGs) and the basic livelihoods of the poor. The persistence of the current path of carbon and material-intensive development will thus weaken the socio-economic and environmental foundations upon which the livelihoods of the poor in Asia and the Pacific depend.

To pursue low-carbon development paths in a more cost-effective way, the following approaches could be taken into account. Similar to the SDGs, these approaches are linked and can contribute to each other, they should therefore be acted upon simultaneously.

Co-benefits approach to attain multiple outcomes: Policies on low-carbon development should be designed in a way that they simultaneously consider and address comprehensively both positive and negative impact, of the multifaceted dimensions sustainable development. Considering the huge resources required to initiate a low-carbon future and the general perception of climate change as relatively low priority when compared to economic development in developing countries, cost-effectiveness and economic benefits will be critical in decision-making. For that reason, policies that bring and reflect co-benefits on climate, economy and wider aspects such as health, will have better cost-effectiveness, perceived as a win-win approach and create better buy-in.

Holistic approach in designing socioeconomic policies: Socioeconomic activities producing GHG emissions have a clear aspect of path dependence of the existing socioeconomic systems. For example, existing infrastructure system heavily influences the behavior of individuals, the structure of subsequent systems, and in turn the trend of the current and future energy

consumption. Transforming existing path entails huge additional costs and often deemed undesirable. The choice of development approach is therefore critical in setting path to future development direction and its flexibility. A holistic approach with consideration of a longer time horizon, multi-sectoral impact and flexibility to adopt new technology is needed from an early stage to design socioeconomic policies and infrastructure to minimize latency costs and lock-in of future actions on climate change and sustainable development.

Cooperative approach to developing and implementing policies: Transition into a low-carbon economy requires new scientific and policy knowledge, frontier technology, and new practices and lessons learnt from multiple stakeholders. To accelerate the development and application of new knowledge, active learning and cooperation among countries is needed. This will not only save time but also reduce institutional and financial costs. Furthermore, cross-sectoral and multi-level cooperation are the prerequisite to maximize the co-benefits and improve comprehensiveness of policies.

Inclusive development approach to enhance access to the provisions of basic services: Actions on climate change should be harnessed to achieve inclusive development by improving access for all, specifically on: mobility, clean water and sanitation, energy, and information and knowledge. In view of the huge unmet gaps in the provision of such services, LCDP should be pursued in such a way that it directly contributes to bridging these gaps while leap-frogging the carbon-intensive trap. In particular, the rapid scaling up of renewable energy at global level and its subsequent improved affordability will have great potential in accelerating growth in both quantity and quality of development.

Failure to adopt more energy- and resource-efficient technologies early on could lead to becoming marginalized and uncompetitive in an increasingly resource-scarce and competitive global economy. Therefore, continuance along the resource-intensive path will not only halt development, but may also widen the existing development gap between the developed and developing world.

In this regard, pursuing a low carbon development path can deliver manifold benefits for the environment and economy at the local, national and global

levels. Against this background, Asia-Pacific developing country policy makers should adopt measures in time for transforming into a low carbon development trajectory. Failing to do so, and continuing on "development as usual", will undoubtedly put the most vulnerable at even greater risk.

## REFERENCES

ADB, *Energy Outlook for Asia and the Pacific*, Manila: Asian Development Bank, 2013.

Bloomberg New Energy Finance (BNEP) and United Nations Environment Programme (UNEP), *Global Trends in Renewable Energy Investment 2015*, 2015 (available at: http://fs-unep-centre.org/sites/default/files/attachments/unep_gtr_data_file_11_may_2015_amc_lm.pdf).

Dornan, M., "Renewable Energy Development in Small Island Developing States of the Pacific," *Resources*, 4, 2015, pp. 490-506.

Economic and Social Commission of Asia and the Pacific (ESCAP), Asian Development Bank (ADB) and United Nations Development Programme (UNDP), "Making it happen: Technology, Finance and Statistics for Sustainable Development in Asia and the Pacific," *Asia-Pacific Regional MDGs Report*, 2014(15), 2015.

Economic and Social Commission of Asia and the Pacific (ESCAP), *Statistical Yearbook for Asia and the Pacific*, 2014.

Erickson, P. and K. Tempest, "Advancing Climate Ambition: How City-Scale Actions Can Contribute to Global Climate Goals," SEI Working Paper, No. 2014-06, 2015 (available at: http://sei-international.org/publications?pid=2582).

FAO, *The State of Food Insecurity in the World 2014*, Rome: Food and Agricultural Organization, 2014a.

_____, *Greenhouse Gas Emissions from Agriculture, Forestry and Other Land Use*, 2014b.

German Watch, *Global Climate Risk Index 2016. Who Suffers Most from*

*Extreme Weather Events? Weather-Related Loss Events in 2014 and 1995 to 2014*, 2016.

Global Wind Energy Council (GWEC*), Global Wind Report 2014 — Annual Market Update*, 2015.

International Energy Agency (IEA), *Energy Efficiency Market Report*, 2014 (available at: https://www.iea.org/Textbase/npsum/EEMR2014SUM.pdf).

_____, *World Energy Outlook*, 2015.

_____, *Key World Energy Statistics*, 2016.

Intergovernmental Panel on Climate Change (IPCC AR5), *Climate change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the IPCC*, 2014.

National Development and Reform Committee (NDRC), *The People's Republic of China First Biennial Update Report on Climate Change*, 2016 (available at: http://www.ccchina.gov.cn/archiver/ccchinacn/UpFile/Files/Default/20170124155928346053.pdf ).

Ramanathan, V. and G. Carmichael, "Global and Regional Climate Changes Due to Black Carbon," *Nature Geoscience*, 1(4), 2008, pp. 221-227.

Ren21, *Renewables 2015 Global Status Report*, Paris, 2015.

United Nations Environment Programme (UNEP), *The Emissions Gap Report 2014*, Nairobi, 2015 (available at: http://www.unep.org/publications/ebooks/emissionsgapreport2014/).

United Nations Framework Convention on Climate Change (UNFCCC), *Adoption of the Paris Agreement*, CP21, 2015.

Urban, F. and J. Nordensvärd, *Low Carbon Development: Key Issues*, Earthscan, 2013.

US International Trade Association (ITA), *Top Markets Report Environmental Technologies*, Washington DC, 2016.

Welt-sichten, *Climate Change and Poverty: A challenge for a fair world policy*, Frankfurt, Germany, 2008.

World Bank, "$CO_2$ Emissions (metric tons per capita)," 2011a (available at:

http://data.worldbank.org/indicator/EN.ATM.CO2E.PC, retrieved on July 23, 2016).

_____, "GDP per capita (current US$)," 2011b (available at: http://data.worldbank.org/indicator/NY.GDP.PCAP.CD, retrieved on July 23, 2016).

World Resources Institute (WRI), *CAIT Climate Data Explorer*, Washington, DC, 2017 (available at: http://cait.wri.org).