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Low Carbon Green Growth in Asia: What is the Scope for Regional Cooperation?* †

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Abstract: *This paper develops a framework to assess the scope of collaboration among countries that are pursuing low-carbon green growth. Much of the policy studies in the area of low-carbon green growth have focused on individual countries or a group of countries. Little attention is given to how countries can work together to pursue the low-carbon green growth agenda. Developing Asia has been witnessing rapid growth in economic activities, both at the sub-regional level and Asia-Pacific wide. There is therefore much scope for market-based and other forms of regional cooperation to augment domestic actions. For example, there are other pressing development needs and resource constraints at the national level that limit the scale or ambition of policies. Regional cooperation can help to overcome those constraints by providing additional resources for incremental costs, technical assistance, and policy support. This paper examines several critical areas such as technology, finance, and capacity building, where regional cooperation will have a significantly greater payoff than will actions by any country alone. The paper concludes with concrete policy actions to realise the regional cooperation potential in developing Asia.*

Key words: climate change, green growth, sustainability analysis, regional cooperation
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1. Introduction

As the world's most populous region as well as one that has to contend with high economic growth, rising share of global greenhouse gas emissions (GHG), and the most vulnerability to risks, Asia has started taking policy actions towards low-carbon green growth. Many emerging economies in Asia have began to shift towards a new sustainable development paradigm that brings competiveness to their industries, alleviates energy poverty and serves growing technology markets (ADB-ADBI, 2013). In recent literature, Yao and Anbumozhi (2015) analysed the driving forces of such low-carbon policy options at the country level. They concluded that integrating climate policies into broader development policies facilitates the transition of major developing economies towards a low-carbon green growth paradigm. These policy actions are voluntary, country driven and compatible with needs of each country. Many other studies (Zhu, 2012; Mathur, 2012, Patnuru, 2012; Doshi, 2012; Howes and Wyroll, 2012; Chotichanathawewong and Natapol, 2012) indicate that it is economically feasible to halt, and possibly reverse, the growth of GHG emissions with Nationally Appropriate Mitigation Actions (NAMA). The debate over low-carbon green growth is focused primarily on current country-level actions.

Successful low-carbon green growth approaches, however, need to be supported by appropriate institutional, financial and technical capacity. Many country-level studies also found that, in the past and present, developing countries in Asia too often plan policy actions that support green growth in a non-linear, mono-sectoral approach but have failed to develop a systematic understanding of opportunities available at regional level (Hasson *et al.*, 2010; Carfi and Shiliro, 2012). So far, only a few studies have explored the linkages of national actions and opportunities available with regional cooperation. Bosello, *et al*. (2003) studied the effects of different equity rules on regions' trade incentives to cooperate. Carraro, *et al*. (2006) showed how appropriate monetary transfers may induce almost all countries to sign a stable climate treaty. Building upon the same study, Brechet, *et al.* (2012) analysed the negotiation strategy for future climate agreements, while Nagashima, *et al.* (2009) looked at different monetary transfer schemes and their impact on participation and abatement costs. These studies are limited in scope in that they focus mainly on equity issues between advanced and developing countries of Asia. On the other hand, others studies (GGGI, 2011; Sachs and Someshwar, 2012) observed that country-level plans in developing Asia are struggling to overcome a slow implementation and witnessing a lack of regionally coordinated approach to collectively take a strong, ambitious and rapid action on climate change as well as to accelerate green growth. Considering the global scope of the climate change challenges and

interdependent nature of economic growth, there is a need for value-driven regional partnerships that are committed to green growth and capable of transforming country-level actions into a collective effort.

International discussions on low-carbon green growth often omit the issues related to the legitimacy and benefits of regional cooperation. In seeking for the answers to the following questions below, traditional thinking on the bounds of actions and the distributional issues are seldom applied beyond state boundaries:

- Do the current policies and practices of low-carbon green growth in Asia, which are situated at the nexus between the market and non-market forces, need regional cooperation to accelerate the transition?
- What are the benefits and disadvantages of working together?
- Does a regional partnership for technology and knowledge diffusion compliment or serve as alternatives to national actions on climate change?

In this paper, these questions are addressed by providing a regional cooperation model and discussing the legitimacy for a networked and regionally coordinated support mechanism that has the potential to tackle climate change issues and accelerate green growth. This paper is organised as follows: Section Two provides an overview of the regional cooperation framework that is based on market and non-market actions. Section Three first assesses the basic individual incentives for countries to participate in a regional coalition by reviewing the current state of low-carbon green growth and then identifies gaps in technology, finance, and capacity building. Based on the incentive needs identified in Section Four, five actions in support for regional cooperation are proposed. In the concluding section, the policy implications of the regional cooperation framework are discussed.

2. A Regional Cooperation Framework to Accelerate Low-Carbon Green Growth In Asia

2.1. The Legitimacy Theory Behind Regional Cooperation

An effective low-carbon green growth cannot be attained by one country alone, but requires considerable cooperation among countries in a region and beyond. It would be neither desirable nor feasible for each country to separately attempt to reduce national abatement costs. That is, it would not be desirable because lower-cost abatement options would be foregone,

and higher cost options accepted (Asuka, 2012; Wyes and Lewandawski, 2012; Hammit and Adams, 1996). It would also not be feasible because there would be no financial incentive for emerging economies to participate in strong climate mitigation efforts that need actions at the global level (Bosetti, *et al*., 2013; Vauren, *et al*., 2009). Greenhouse gas mitigation and green growth costs of emerging economies may be lowered by regionally coordinating the flow of technology and finance as quickly and as widely as possible.

Thus, regional cooperation in accelerating low-carbon green growth involves a networked system. Addressing the operating challenges and investment issues related to low-carbon development will require a wise combination and adaptation of market and non-market options (Carfi and Schiliro, 2012). In that sense, regional cooperation and transnational partnership could be defined as cooperative arrangements between countries that have a common understanding and objectively address the challenging issues of technology transfer and finance as well as capacity building needs. This can be characterised by an institutionalised cooperation among public (governments and international organisations) and private actors (corporate and civil society) to capitalise the market forces.

Open regionalism is already progressing in Asia with the proliferation of free trade agreements and evolving monetary policy coordination mechanisms. These market-driven regional cooperation efforts have the potential to complement and strengthen the present and future climate mitigation agenda and pool together diverse resources due to its flexibility (Aminian, 2005). The benefits from regional cooperation can be felt once there is an institutionalised arena where different levels of efforts from private and public parties collectively work to provide for a global public good such as climate change mitigation. Given the current trend in GHG emissions and the latest round of stalled global climate talks, the traditional ways of problem solving are no longer sufficient. Innovative actions that can accelerate the paradigm shift should be brought about by a regional architecture so as to avoid the tragedy of commons.

2.2. Mapping the Landscape for Regional Cooperation

While countries face different challenges and needs in managing their transition, jeopardising the benefits from low-carbon green growth is never an option. This thus involves some balancing act. That is, how can major developing economies cooperate to maximise the efficient and equitable use of resources, while meeting the challenges in ensuring economic stability and growth?

Low-carbon green growth is an inclusive development model that improves resource efficiency and mitigate climate change while generating a number of co-benefits, including

accelerated job creation, healthier population, expanded access to secure energy supplies, and sustained economic growth (ADB-ADBI, 2013). Policies needed to achieve the goal have been identified and are known to stakeholders. However, mobilising the required scale of technology, finance, and knowledge is the core of the implementation deficit and demands new cost-effective approaches to accelerate the process (Bosetti, *et al.*, 2013; Cho, *et al.*, 2014).

Emerging Asian economies need to do all these (i.e., deploy existing energy efficiency and low-carbon technologies, develop new goods and services as well as infrastructure) on a hitherto unprecedented scale. The most effective way to address this challenge is to develop a market framework that stimulates and scales up low-carbon technology investment. Over the period to 2035, the investment required by Asia to stabilise the climate to 450-ppm carbon scenario is estimated to be US$380 billion (IEA, 2014).

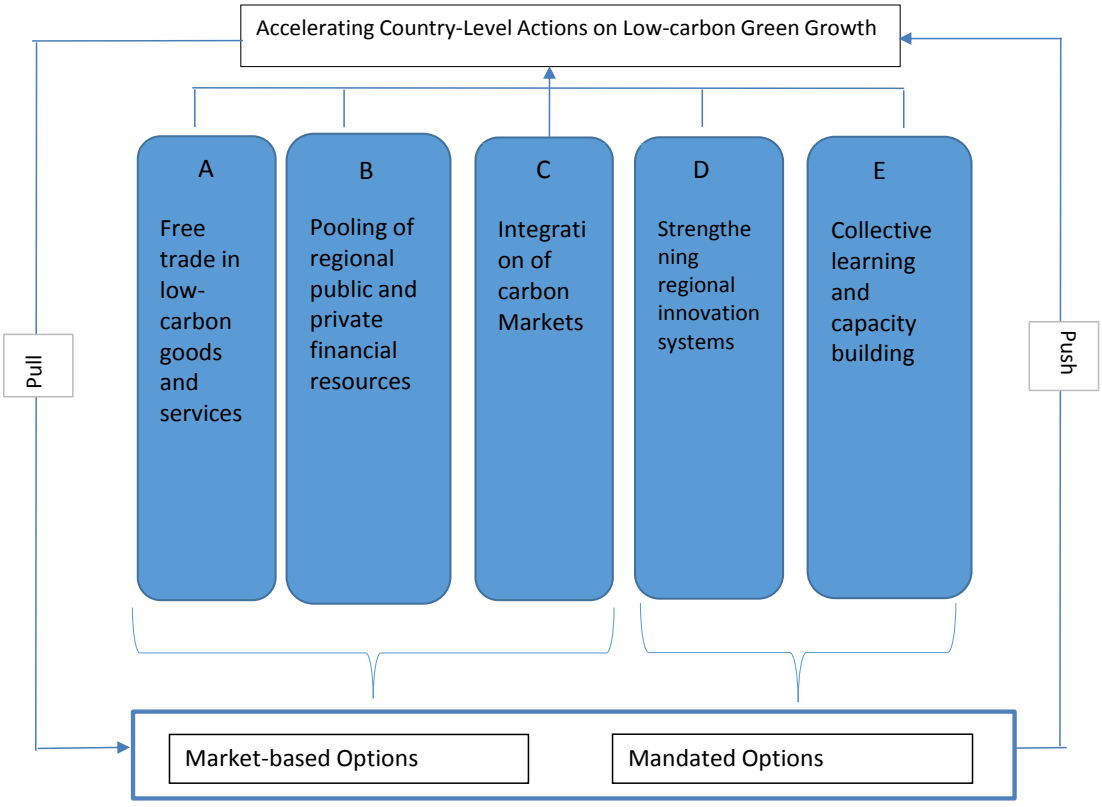
New financing models to catalyse the regional resources' economic and environmental benefits are needed. Policy actions to address low-carbon development are already happening in Asia, and many different emission management systems such as cap and trade are being introduced at the country level. Such clear recognition of the carbon markets as an internal part of global and domestic efforts to mitigate climate change adds a new dimension to low-carbon green agendas.

Creating a regional carbon market will establish a single carbon cost and will create equitable access to the prevailing low-cost abatement opportunities. Nevertheless, the region is vastly underinvesting in innovation system that can catalyse domestic capacity to develop, adapt and diffuse beneficial technology and business models. Experiences in Japan and Korea indicate that effective low-carbon innovations need to encompass not only the hardware of technology but also the software of knowledge management (Ramanthan, 2012; Asheim *et al.*, 2006). Both the knowledge base and learning economic rationale argue that in the global economy, knowledge is the most strategic resource, while learning is the most fundamental activity that can bring economic competiveness.

Then the question that needs to be explored now is how a combination of "pull" by regionally coordinated actions and "push" by domestic actions will bring positive changes and engage developing Asia in international efforts. For that, the following measures are identified to help enhance, directly or indirectly, the regional cooperation architecture as well as have the potentials to augment current country-level efforts on low-carbon green growth.

A. Free trade in low-carbon technology and services
B. Integration of carbon markets
C. Managing the regional financial reserves
D. Coalition for regional innovation systems
E. Partnerships for collective learning and capacity building

Figure 1: A Regional cooperation framework for pursuing low-carbon green growth in Asia



As illustrated in **Figure 1**, it is possible to classify the basic regional cooperation pillars into market and non-market choices. Specifically, improvements in trade, carbon markets, and financing architecture at the regional level (A, B, C)--which are based on the market principles---can reduce the cost of implementation directly. These have the potential to solve some of the issues related to increasing share of low carbon technologies and achieving energy efficiency targets. Implementing these basic measures may be less challenging since there are already inherent certainties associated with ongoing regional economic integration process. If this is the case, additional measures should be considered. In a dynamically and rapidly changing economy, it is necessary to pay attention to innovations and knowledge sharing as processes that are equally important as national competency building. The capacity mechanisms indicated in D and E are hybrid solutions between a market oriented and a regulated one, where government's lead role is necessary. Nevertheless, such capacity building arrangements may well be necessary to cope with the transition in

an environment wherein regulatory measures and market failures are common rather than the exception.

3. Country Actions Versus Regional Cooperation for Low-Carbon Green Growth in Asia: Lesson Learned

3.1 Meta-Policy Analysis Method

The above analytical framework was used in this study to examine whether current policy actions are necessary enough to drive low carbon green growth efforts at the national level. Benchmark meta-policy analysis set for a regional study on Low Carbon Green Asia (ADB-ADBI, 2013) was used to assess if technologies, financial arrangements and capacity building efforts are on track to achieve the NAMA targets. The meta-policy analysis introduced by Yao and Anbumozhi (2014) is a useful tool to identify the drivers of low-carbon green growth and to develop deep insights on robust policy changes taking place at different levels of the government. Thus, this study coordinated several assumptions on low carbon green growth within the context of developing Asia and introduced feedback that is absent in conclusions of peer-reviewed publications.

The meta-policy analysis covered national development plans, sectoral plans and targets for energy efficiency improvement and renewable energy mix as well as policies that support market capitalisation, local government actions, private sector development and economic integration. Since GHG reporting remains sparse in the region, the NAMAs in National Communications (NC) to the United Nations Framework Convention on Climate Change (UNFCCC) were studied in detail to assess the policy impacts on GHG emissions. Based on other available data and information, the progress of current policy actions towards regional cooperation was also assessed.

3.2. Scaling up Trade and Investment in Low-carbon Technology

Low-carbon technology and services help in climate change mitigation by lowering the total cost in stabilising GHG emissions. The Intergovernmental Panel on Climate Change (2007) has defined three major categories of technology, namely: (i) generic large-scale technologies (e.g., end-use efficiency, advanced electricity generation from fossil fuels, carbon capture and storage, alternate energy sources---biofuel, wind, hydro, solar, geothermal); (ii)

sector-specific, large-scale technologies (e.g., energy efficiency in manufacturing, forestry, agriculture); and (iii) micro-level mitigation technologies (e.g., methane digesters, fuel efficient stoves, etc) where advancements should be made by 2020.

Supported by strong domestic policies, the rapid absorption of the above technologies (particularly in renewables and energy efficiency) is observed in Asian countries. In 2012, China, India, and Indonesia accounted for 32 percent of new installations at global level, becoming the largest markets in the world for both wind and solar (IEA, 2014). However, the flow of technology transfers has traditionally been from developed to developing countries. Given their position on the economic growth path, these emerging countries are well placed to take advantage of opportunities offered by expanded international trade and investments in low-carbon technologies.

Table 1 gives an overview of low-carbon energy policies, and trade and investment policies in major developing countries of Asia. Energy policies in the Chinese government's 12th five-year plan are directed at reducing the energy intensity of GDP by 20 percent below as well as reducing emissions of major pollutants by 10 percent. Implementation of carbon reduction targets increases the absorption of low –carbon technologies. Accordingly, since 2006, four major pieces of legislation have been enacted in China to address the issues of cross-border investment in low-carbon technologies, to promote tax equality across foreign and domestic enterprises, to establish formal property rights and to revamp market-based competition (Zhu, 2012).

Table 1: Overview of low-carbon energy and FDI policies in major Asian Economies

Country	Energy Policy		FDI Policy	
	Policy	**Objective**	**Policy**	**Objective**
China	Public sector energy savings regulation	Promote energy savings	Catalogue for the Guidance of Foreign Investment Industries (2003, 2007)	Instrument for addressing macroeconomic/sectoral economic & growth objectives
	Civil energy bill	Promote the use of renewable and alternative energy sources in newly constructed buildings		Measures: (-) Divides economic sectors into "prohibited", "restricted", "permitted", and "encouraged" with respect to FDI; (-) 2007 changed focus, encouraged FDI on technologies providing environmental protection, energy efficiency and recycling
	Law to promote circular economy	Increase re-use and recycling of materials	Regulations on the Acquisition of Domestic Enterprises by Foreign Investors (2006)	Address concern about: (-) Risks posed by powerful foreign-owned enterprises to Chinese economic security; and (-) Risk posed by expansion of foreign business to expansion and innovation of domestic enterprises.
	China Coal Legal System Framework	Coordinate electric power generation and mining industry		
	Solar PV subsidies	50 percent subsidies		Measures: (-) Delineation of "no go" sectors for foreign enterprises; (-) preferential import tax incentives for intermediate goods.
	Investment in hydroelectric facilities	Investment of US$125 billion		
			Enterprise Income Tax Law (2008)	Encourage domestic development of technologies and sustainable economic development
				Measures:
				(-) Remove concessionary taxes for foreign enterprises

				(-) Special incentives for renewable energy investment irrespective of ownership
			Property Rights Law (2007)	Establishes private property rights
			Anti-Monopoly Law (2008)	Framework to regulate market competition
Indonesia	National Energy Law (2006)	Reduce Energy dependency	Law No 25/2007 on Investment	Attract overseas investment
		Change energy mix	Government regulation No 1/2007 on Income Tax Facilities	Measures:
		Reform of energy pricing		(-) Incentives for new investors or expanding existing investors, provided some conditions are met (-) Consistent legal status of domestic and foreign enterprises (-) Protection of Property rights (-) Easing of immigration regulations (-) Creation of central coordinating body
	Green Energy policy (Ministerial Decree 2/2004)	Increase due of renewable energies		
		Increase education		
	Small distributed power generation using renewable energy (Ministerial decree 112/K/30/MEM/2002)	Incentives for small scale renewable power facilities		
	Medium-scale power generation using renewable energy (Ministerial regulation 2/2006)	Incentives for medium-scale renewable power facilities		
	Public/Private initiatives	Micro-hydroelectric	Presidential Regulation No. 76/2007 on requirements for investment	Encourage domestic growth and employment
		Energy self-sufficiency village programme		Measures: (-) Various criteria relating to technology transfer, location of investment, and training & employment of Indonesian workers (-) Creation of Special Economic Zones (SEZ)
		Solar home system programme		
	10,000 MW Crash Program (Presidential Decree 71/2006)	Construction of 10,000MW coal fired capacity by 2010		

		Construction of 10,000MW coal fired capacity by 2009-14)	Presidential Regulation No 77/2007 on negative and positive lists of investment	Protect certain sectors of the economy
	Bilateral Energy Cooperation Indonesia-Netherlands (BECIN)	Promote the use and deployment of renewable energy resources		Measures: (-) Negative investment list re restrictions/prohibition on foreign investment
Thailand	Energy Supply Policy (2008)	Energy security	Directive to promote investment in renewable industries	Encourage investment in targeted CFTs
		Monitoring of energy prices		Measures:
		Promotion of alternative energy production and R&D		(-) Tax Incentives (-) Import duty exemptions (-) Discount from transport, electricity, and water cost
		Energy savings and energy efficiency		
	Energy Conservation Plan (2009)	Environmental goals		
		Increase the share of renewable energy to 8 percent by 2011	Investment incentives for certain provinces (2009)	Encourage investment in targeted locations
				Measures:
				(-) Tax Incentives (-) Import duty exemptions (-) Incentives for infrastructure development
			Thailand Investment Years initiatives (2008-2009)	Encourage investment in targeted industries
Vietnam	National Energy Development Strategy (2009)	Increase share of renewable	Certification requirements	Requirements to certify foreign-led investment projects

		Installation of nuclear power plant	Special zones	Creation of geographic zones to attract FDI
		Competitive markets for electricity, coal, oil and gas		
		Rural energy programme		
			Law on Competition (2004)	Framework to regulate market competition
	Vietnam Power Sector Development Strategy (October 2004)/ National Energy Strategy Development (December 2007)	Development of renewable energy	Law on Technology Transfer (2005)	Create framework for promoting and restricting certain types of technology transfer
	Other policies	Incentives for international investment in domestic fuels	Law on Investment (2005)	Regulate investment
		Diversification of energy sources		Measures: (-) Lists forms of allowed private sector investment (-) Lists sectors closed to foreign investment
		Incentive for exploitation of domestic fuels		
			Law on Enterprises (2005)	Establish modern company structures
			Law on Intellectual Property (2005)	Establish intellectual property rights

Source: Zhu, 2012: Chotichanathawewong and Natapol, 2012; Mathur, 2012; Kang, 2012.

Meanwhile, India in 2008 announced five renewable energy missions to run until 2017 so as to achieve the carbon intensity targets of 25 percent compared to 2005 levels. That was accompanied by a strengthened foreign direct investment (FDI) framework that provides automatic approval and tax breaks for overseas investors. In Indonesia, its government announced a National Energy Law in 2008, the country's first piece of legislation on energy that sets the goals for protection of the environment with targets on biofuel, natural gas and other alternate sources. Over the years, the Indonesian government has initiated a number of reforms in FDI that include the creation of incentives for new investors, harmonisation of the legal status of foreign enterprises, protection of property rights, creation of a central coordinating body and establishment of special economic zones for low carbon equipment-makers.

Promotion of energy security based on the principles of self-reliance is the core low-carbon, green growth paradigm of Thailand. To achieve that, the Thai government encourages entrepreneurs to undertake joint ventures in cross-border hydropower projects and low-carbon technology deployment in domestic markets by providing the latter with tax incentives and import duty exemptions. Viet Nam also gives greater emphasis on the security of energy supply in its low-carbon green growth plans through progressive liberalisation of restrictions on international technology and capital flows. The above policy initiatives prove that there is great diversity in the policy instruments countries can apply to efficiently deploy low-carbon technologies.

Furthermore, the Free Trade Agreement (FTA) network has been steadily expanding in the region since the 2000s. It is worth noting that the ASEAN+1 network and ASEAN Free Trade Agreement completed in 2012 accounted for a 12 percent increase in general technology and capital flows. Developing Asia can use the momentum created by these agreements in its bid to expand the penetration of low-carbon green technologies.

However, the utilisation ratio of the FTAs remains low----for example, 42 percent for Thailand; 3 percent for Vietnam; and 24 percent for Malaysia (Baldwin, *et al.*, 2014). While the tariff rates for a number of automobile, electronic and manufacturing technologies have been eliminated, the tariff rate for low-carbon goods and services in the region remains in the range of 12 percent to 50 percent, with high tariff rate observed among low-income countries (Kalirajan and Anbumozhi, 2014; Mikic, 2010). High tariff and non-tariff measures on low-carbon goods and services hinder the wider use of these technologies. Kalirajan (2012) estimated that the complete elimination of tariffs and non-tariff barriers (i.e., tariff free and quota free) would lead to an average increase of trade in wind and solar power energy generation and energy-efficient lighting technology by 13.5 percent at the current level, with

variation across technologies and countries. The elimination of tariff alone would raise trade by around 7 percent from its current level, which then translates to a 9 percent total reduction in the region.

At present, there are difficulties in current systems arising from unnecessary and unwieldy multiple administrative levels and potentially contradictory pieces of legislation pertaining to line ministries. In most cases, low-carbon investment projects and technologies are required to undergo certification process across the ministries. This requirement adds another layer of complexity to the implementation of low-carbon technology transfer projects.

3.3. Transformative and Prioritised Financing for Low-Carbon Green Growth

Although there are many low- or negative-cost opportunities to reduce or avoid carbon emissions, there is still a net cost to adopting a low-carbon pathway, albeit small in comparison to the economic growth that can be expected over a period. Financial investment in low-carbon energy systems itself is estimated to be at US$150 billion in 2035 for China, India, and Southeast Asian countries in 450 scenarios, although the lack of clarity over policies could increase this risk. In China, the cost of realising the low-carbon scenario was estimated at US$84 billion while in India, the additional investment to achieve the all-out scenario in terms of energy plant retrofitting, efficiency improvement and new capacity for grid-supplied renewable electricity is estimated to have a net present value of US$33 billion by 2035 (IEA, 2014).

The size of funding required necessitates use of a wide range of financial mechanisms, whether public or private, domestic or international. At the national level, the revenue from new taxes on emissions and pollution is used as a strategy to boost low-carbon investments. Aside from the revenues gained, other economic benefits from an environmental levy, such as carbon tax, are reduced CO_2 emissions and decreased consumption of fossil fuels. In 2005, Japan introduced an environmental tax of US$28 for each ton of carbon, which resulted in an additional revenue of US$4.2 billion. That revenue is recycled to support energy-efficient buildings, low-carbon technologies for automobiles and forest absorption source-based programmes.

India has become the first Asian country to introduce carbon tax on coal in 2010 as part of its NAMA. The Chinese National Development and Reform Commission has introduced carbon trading schemes in Beijing, Chongqing, Shanghai and Tianjin, and the provinces of Hubei and Guangdong in 2013, with a view to encourage investment in low-carbon infrastructure. Meanwhile, South Korea introduced carbon taxes in 2012 but the plans for the

additional use of the revenues are yet to be announced. Currently, a commission is reviewing and analysing several economic instruments, including carbon taxes imposed on GHG and a cap-and-trade scheme. Given that a quarter of the developing Asian population lives below $1.25/day poverty line and more than half of the population still live below $2.00/day poverty line, additional revenue generated from eco-taxes might be diverted to other basic human needs in those countries.

Gaining a comprehensive picture of the private financing landscape is complicated due to the absence of common definitions as well as inconsistent reporting and tracking methodologies. A study conducted by Climate Policy Initiative (Sudo, 2012) estimated that at least US$97 billion of climate finance is currently being provided at the global level. Of this, the amount of private financing is almost three times greater than that of public financing. There is a disparity in private sector finance depending on the countries' economic circumstances. According to the data from Global Development Finance (GDF, 2011), US$378 billion has been invested in Asian developing countries. Out of this, a large part of the FDI to Asia goes to China (US$254 billion). Among the developing Asian countries, the top 10 recipient countries--e.g., Singapore (US$39 billion), India (US$24 billion), Indonesia (US$13 billion), Kazakhstan (US$10 billion), Malaysia (US$9 billion), Viet Nam (US$8 billion), and Thailand (US$6 billion)--account for 97 percent of FDI inflow in Asia.

International climate finance is also important, but because of high demands, some prioritisation will be required. Based on the Japan International Cooperation Agency (JICA) and Asian Development Bank (ADB) funding in Asia, funds for readiness activities (economy-wide and sector-specific low-carbon planning), transformative policy changes (detailed implementation of recommendations), and first-of-kind investments (for demonstration and to overcome real or perceived risks) are proposed as high priorities as these are likely to achieve the greatest return. A report by Anbumozhi and Putnuru (2011), which summarised climate change financial flows into Asia and the Pacific region based on the data extracted from Climate Fund Update (CFU), indicated that a total of US$1.73 billion for Asian countries has been approved between 2004 and 2012 and approximately $866 million of this approved funding has been disbursed from dedicated climate change funds.

Out of the total inflows, attracting sufficient private capital to low-carbon investment is a major challenge, as those projects tend have high up-front capital expenditures as a share of project cost. Higher unit capital costs and risk premiums mean that low-carbon investments may suffer disproportionately in the event that banks and other institutions retreat from providing long-term finance due to Basel III capital adequacy requirements (Hongo, 2012). Furthermore, the dispersed, diverse and small-scale nature of many low-carbon investments

such as small-scale renewables and energy efficiency makes it difficult to package them and securitise credit to investors, which is a key instrument to reduce risk. The financial community needs to appreciate the distinctive nature of such investments and develop suitable vehicles to finance low-carbon projects in a way that aligns with their varying sizes, operational models and investment objectives. Current finance vehicles for pooling regional investments in low-carbon energy projects in Asia are illustrated in **Table 2**.

Table 2: Selected Concessional Financing Vehicles for Regional Pooling of Investments in Asia for Low-carbon Actions

Category	Description	Typical Application	Actors	Advantage
Green bonds	Fixed income debt securities	All mature low-carbon technologies, predominantly wind, solar and cross-border hydro	Principally issued by governments, international financial institutions, multi-national banks or corporations	High degree of security when backed by governments
Special purpose vehicles	Leasing scheme using debt facilities available	Energy efficiency in SME, micro-generation, afforestation programmes	Provided from government financial institutions or investment banks to provider or utilities	Can be leased to end-users to reduce the impact of cash flows, while giving access to large-scale debt finance
Pooled vehicles	Private equity funds, green infrastructure funds, and other listed vehicles	All mature low-carbon technologies, predominantly wind, solar and cross border hydro	Issued by asset managers or specialist private equity funds with guarantee from bilateral and multi-lateral financial institutions	Exposure to companies or assets for small investors

Source: Hongo, 2012; Kim, 2012; Anbumozhi and Putnuru, 2011.

In financing low-carbon investments, the possibility of tapping into huge regional resources held by sovereign wealth funds and institutional investors shall be a good strategy for collective action. Sovereign funds include pension funds and foreign exchange deposits in US treasury. Institutional investors include insurance companies, infrastructure investment

funds, etc. In emerging Asian economies, sovereign wealth funds are key sources of capital, with US$6 trillion assets in 2012. The foreign exchange reserves are estimated to be in the order of US$7 trillion. Establishing regional agreements such as special drawing rights (SDR) for low-carbon green growth can help tap these resources.

3.4. Emission Trading and Carbon Markets

Developments in Asia over the past years have given a major boost to global carbon markets, an acknowledgement of the growing role that markets play in national efforts to reduce GHG emissions. Many emission trading mechanism initiatives are meant to meet national and Kyoto targets. Some are driven voluntarily by business. Japan, China, India, and Korea are now at the forefront in proposing innovative systems, whereas they lagged behind in their usage of tradable permits in the past (Kim, 2012). The Tokyo Cap-and-Trade Program is the world's first carbon market programme targeting urban facilities. The programme started in April 2010 and so far has been successful. In 2011, emissions had been reduced to 23 percent compared to the base year. This is a further 10 percent from the first year in 2010, which showed to 13 percent reduction in 2011 (ICAP, 2014). In 2011, China approved a pilot trading scheme in seven provincial regions so as to encourage carbon emission reductions. In 2012, as a market-based emissions reduction policy measure, India launched a scheme called Perform, Achieve and Trade (PAT) to improve energy efficiency. Here, industry operators are assigned tradable qg. uotas, and the energy efficiency is increased. These lead to the creation of domestic markets for domestic players.

Table 3 shows the sectoral coverage of emission trading systems in Asia. They vary across systems, depending on local needs, economic structure, and carbon market capacity. Key considerations in this regard include the largest emitting sectors in a given jurisdiction and the available abatement options. Some sectors, like the power or industry sector, are included in the scope of all emission trading systems.

Table 3: Sectoral Coverage of Emission Trading Schemes in Asia

Emission Trading schemes	Sectoral Coverage					
	Power	Industry	Transport	Buildings	Waste	Forestry
Tokyo		◙		◙	◙	
India -PET	◙	◙				
Kazakhstan	◙	◙				
Shenzhen	◙	◙		◙		
Shanghai	◙	◙	◙	◙		
Beijing	◙	◙		◙		
Guangdong	◙	◙				
Tianjin	◙	◙				
Chongqing		◙				
Hubei	◙	◙				
Korea	◙	◙	◙	◙	◙	◙
Total number of systems at global level*	13	15	6	5	3	1

Note: * Includes EU-ETS, US-RGGI and New Zealand
Source: ICAP, 2014.

At the international level, the Clean Development Mechanisms (CDM) was designed to help developed countries meet a part of their emission reduction targets on carbon-offset principles. The projects of the CDM provided certified emission reduction (CER) credits, which could be traded or sold by participants in the projects. To date, market creation through CDM is highly concentrated in a few developing countries of Asia. As of December 2012, 37 percent of CDM projects in the pipeline were located in China and 27 per cent in India. The remaining 36 percent are shared by other nations. By 14 September 2012, the CDM Board had issued 1 billion CERS, 60 percent of which originated from projects in China. India and the Republic of Korea

were issued with 15 percent and 9 percent of the total CERS, respectively. The Himachal Pradesh Reforestation Project in India is claimed to have the world's largest CDM (Anbumozhi and Putnuru, 2011).

Within each type of carbon market---either emission trading systems or CDM---different emission management approaches are being implemented, creating a different carbon cost within its targeted sector or country, either explicitly through the incremental cost of policy requirements. These fragmented markets also are not favourable to investors, as the transaction costs are more. On the other hand, a regional carbon market that links different emission management approaches together will establish a single carbon cost and create equitable access to the prevailing lowest-cost abatement opportunities.

Integrated carbon markets will deliver a number of benefits. They will expand the scope and diversity of low-cost abatement opportunities, thus enhancing the cost effectiveness of reduced emissions in participating countries. Deeper and more liquid carbon markets will also operate more efficiently and effectively provided there is a strong confidence in the governance and credibility of the markets (Asheim, *et al*., 2006). As regional carbon markets develop, price volatility should decrease because supply and demand for permits will be less dependent on a single country or region's short-term economic outlook. Linked markets decrease transaction costs for business with liability under various schemes, and reduce the risk of competiveness impacts on business and of potential carbon leakage (Froyn and Hovi, 2008).

Linkages among the carbon markets occur when one system recognises the market instrument (e.g., allowance) operating within another system and allows its use to meet the compliance objective of the first system. For example, Japan's Tokyo ETS recognises China's Shanghai ETS and permits the use of CER to meet the compliance requirement of a facility in Shanghai. A regional agreement to integrate markets could take a step-wise approach, which allows linkages between various national approaches, covering both direct emission management and the need to offset emissions. A signatory country may choose multilateral participation in the regional carbon market by accepting, at the national or sector level, a fixed carbon emission budget for a given future period. Alternatively, the signatory country may choose to begin the task of

managing the emission without participating multilaterally, but instead engage in regional trade through unilateral recognition of project mechanisms.

In any case, the unilateral recognition and bilateral arrangements such as Japan's Bilateral Offset Credit Mechanisms (BOCM) may also play a role in unifying the currently fragmented markets.

3.5. Regional Innovation Systems and Localised Learning

Countries that will be competitive in the 21st century are those that innovate, move to clean energy, and reduce emission intensity of their economic growth. For that, they require diverse technology responses across many economic activities and sector. Some of the highest-profile technologies intrinsically require very large-scale funding on discrete projects. However, it is a myth to think that the only technologies that matter are those that are big and centralised such as carbon capture and storage. On the contrary, the recent 5th Assessment Report and IEA (2014) found that the biggest potential for emission reduction lies in more energy-efficient technologies across the sectors. About 50 percent of the emission reduction could be achieved by introducing new small-scale technologies and services (product innovation) or by implementing new production process (process innovation). In its broadest definition, a national innovation system represents new creations of economic significance, and encompasses radically new technologies or a combination of existing technologies that bring novelty or intangible services (Ramanthan, 2012; Kumar, 2012). This is also the basis for a knowledge-based economy. Investment in R&D is one of the main routes of innovation.

The pattern and pace of innovation in Asia has been mixed, with some countries leading the world in innovation according to some measures, while others have failed to benefit as much. The absolute level of annual investment in R&D in countries such as China, India, Japan, and Korea is now substantial. However, R&D as a percentage of GDP varies considerably. Korea and Japan have levels comparable to that of the United States, while India and China are somewhat behind. Similarly, the number of scientists and engineers as a proportion of the population is higher in some Asian countries (e.g., Japan, Singapore, Korea and Taipei, China). Some Asian nations have very low R&D spending as a proportion of their GDP: Figures for Thailand, the

Philippines, Viet Nam and Indonesia are 0.25 percent or less. According to Fischer and Newell (2008), low- and middle-income economies increased their share of global R&D expenditure by 13 percent between 1993 and 2009, with China accounting for most of this increase---more than 10 percentage points---propelling China to be the world's second largest R&D spender in 2010.

There is still considerable scope for many Asian countries to increase their innovative activities in these areas, and tailor the results of innovation to their needs. According to World Bank (2008), water pollution control technologies in developing countries tend to rely more frequently on local innovation than do air pollution control technologies, because local conditions are more important in shaping what these technologies have to do. They are also less likely to have been patented elsewhere. Kang (2012*)* found that the most common climate-friendly patented innovations in China and Korea included technologies designed primarily for local markets, such as geothermal and cement manufacture. Specifically, process innovation can be tailored to the mix of inputs available to the country concerned: Many Asian countries have abundant unskilled labour but are less endowed with raw materials and energy resources.

Part of the rise of innovation in several Asian countries come from efforts to start the transition to low-carbon green growth. China and Korea, for example, have moved up the rankings for patenting "green" innovations. China's 12th Five-Year Plan envisages increasing R&D expenditure to 2.5 percent of GDP by 2015, focusing on seven key strategic industries that help it move towards greener growth: environmental protection and energy efficiency; new types of energy supply; next generation information technology; biotechnology; high-end manufacturing; clean-energy vehicles; and high-technology materials.

On the other hand, in the midst of acute social development needs and limited budgets, why and how can governments of low–income countries invest in innovation? **Table 4** shows the type of local barriers to technology adoption in developing Asia and interventions required. It is useful to think of investments in low-carbon innovations as a staged process where adjustment are made based on their level of development. Sub-regional-level cooperation can help the group of same-stage countries overcome their barriers. It is worth noting that there is large heterogeneity

of low-carbon technology needs among developing Asian countries, some of which also hold pockets of excellence in certain sectors and technologies such as in the case of Indonesia for biofuel; India for solar power; and China for wind energy. These developments are not only based on cheap labour but on the process improvement and business model innovations as well (Mohanty, 2012).

Table 4: Local Barriers to Innovation and Intervention required to Address Specific Barriers

Activity	Gaps/Lessons Learned	Benefits of regional cooperation
Applied Research and Development Grand funding, open and/or directed at prioritised technologies	Inadequate support for relevant applied research for technologies where funding is minimal due to classic innovation barriers	New ideas from local knowledge base applied and developed to point of potential commercial value
Technology Accelerator Designing and funding projects to evaluate imported technology performance	Uncertainty and scepticism about *in-situ* costs and performance, and lack of user awareness	Reduction in technology risks and costs by independent collection and dissemination of performance data and lesson learnt
Business Incubator Services Strategic and business development advice to start ups	Lack of seed funding and businesses skills within research/technology start-ups; cultural gap between research and private sectors	Investment and partnering opportunities created by building a robust business case, strengthening management capacity and engaging the market
Enterprise creation Creation of low-carbon businesses by bringing together key skills and resources	Market structures, inertia, lack of value impede development of new low-carbon products and services	Development of local commercial and technical capabilities and creation of new high-growth business to both meet and stimulate market demand
Early Stage Funding for low-carbon techno ventures Co-investments, loans or risk guarantees to help viable businesses	Lack of financing for early stage, low-carbon businesses due to classic innovation barriers combined with perceived low-carbon market/policy risks	Enhanced access to capital for emerging business that demonstrate commercial potential. Increased public and private sector investment in the sector that demonstrate potential investor returns

Deployment of existing low-carbon technologies Advice and resources (e.g., interest free loans) to encourage organisations to reduce emissions	Lack of awareness; information and market structure limit uptake of cost-competitive energy efficient or low-carbon technologies	Improved use of resources by enabling organisations to implement energy-efficient measures and save costs. Catalyse further investment from organisations receiving support

Source: Ramanathan, 2012; ADBI, 2013a; ADBI, 2013b; and KDI, 2014.

Conversely, within each Asian country, firms with very different levels of technological capabilities co-exist, and the kind of innovation process needed by less-advanced small industries, for example, is completely different from the demands of most technically competent firms in advanced economies. Therefore, it would be risky and costly to apply predetermined technology prescriptions across-the-board to Asian countries at each level of development. Instead, countries with the same level of development or economic structure can develop comprehensive innovation policy strategies that will combine supply and demand side measures, cut across functional and administrative boundaries, and build upon open innovation processes and regional cooperation. Fiscal constraints and increasing cost of financing the imported technologies in many developing countries make it necessary to search for cost-effective solutions on the specific technological areas best suited for country- or sector-specific low-carbon green growth goals. In many developing Asian countries, these challenges are compounded by the lack of a central organisation that can help bring together the academic, business, and policy-making communities to address the low-carbon innovation challenges. Establishing a network of low-carbon innovation centres across countries and sectors could address both local and regional barriers to technology.

The motivation for establishing low-carbon innovation centres based on public-private partnerships (PPP) may fall under two categories:

- First, there are the direct benefits to the low-carbon technology concerned, as the centres will allow the innovation to be performed or applied to local needs and potentially reduce the costs of technology interventions more quickly and economically than without cooperation among the countries.

- Second, there are the indirect benefits arising from the cooperation. These may occur dynamically in the course of building a knowledge-based economy, where the collaboration across the countries is driven by external goals of political, economic and cultural nature. For example, as indicated in **Table 5**, with the access to the expanded market, costs and risks are shared in building a strong business incubator services programme. Smaller enterprise creation or exchange/visit programmes can provide the means to attract large-scale funding as such activity can have reputational benefits, which then can attract investments.

Table 5: Summary of Policy Actions and Capacity Building needs to Accelerate Low-carbon Green growth

Policy Regime	NAMAs covered	Lessons Learned and Capacity Building Needs				
		Economic	Institutional	Technical	Legal	Financial
National Strategies and Plans	Low-carbon development strategies, national mitigation strategies, national action plans	Evaluating cost effectiveness of NAMAs using modelling as well as funding for implementation	Coordination between government agencies at national and local level	Identifying and evaluating potential NAMAs, developing baselines and national emission projections and identifying and assessing mitigation options		Full agreed costs approach
National Policies and Measures	General economic/fiscal measures, regulation and standards, market-based measures, R&D Capa, and Trade Carbon Tax	Analysing emission reduction alternatives, costs and calculating a target or the tax level	Create capacity in the national institutions that will implement CAC and MBI	Formats and measures for MRV system; Design and implementation of systems for tracking the trading of domestic allowances; Determining and	To create a national target instrument for adopting the rules and procedures	Resources necessary to design and implement the schemes; Co-financing emission reduction schemes with

				collecting tax from regulated sources		resources from advanced countries through financial mechanisms or carbon market.
Sectoral Programmes and measures	Regulation and standards; Preferential taxes; Performance standards Subsidies and low interest loans; Voluntary energy reduction programmes	Evaluating cost effectiveness of sectoral mitigation activities/technologies as well as for the request of funding for implementation	Organisational strengthening for enforcing mitigation activities	Identifying and evaluating potentials for emission reduction and associated mitigation activities or technologies	Depending on mitigation activity needed for regulations and standard settings	Financing for design phase, full cost through IFI; Co-financing by advanced economies through financial mechanism or carbon market
Sub-national level Programmes	Institutional reforms, adjustments to governance; Enhancement of enforcement capabilities; Performance-based licensing	Fore designing incentives for energy conservation	Institutional strengthening for enforcement capabilities; Multi-stakeholder consultation	Create sound and periodical national, city monitoring programmes	Legal concealing for institutional, urban planning and land use reforms	Full cost financing of pilot phase activities; Co-finance of measures through market incentives or funds. Full cost finance of MRV requirements

Source: ADB-GGGI-CDKN, ADB, 2012: SNU-ADBI, 2012; ADB-ADBI, 2013; KDI, 2014.

3.6. Learning Economy and Low-carbon Green Growth Knowledge Base

Low-carbon green growth is a relatively young field of public policy practice. In essence, it involves development policy-making that factors in environmental, industrial and social risks and opportunities. The key question then is: What are these specific, viable opportunities open to the government so as to achieve social and environmental benefits and help stimulate broad-based economic development?

Low-carbon development was not, and will not be, an easy political path for many developing countries in Asia. Indeed, it will take a number of attempts before they can succeed. In learning economies, public policy-making is understood as an interactive learning process, which is socially and territorially embedded and culturally and institutionally contextualised (Anbumozhi and Bauer, 2013). Access to a stock of specialised knowledge is the key that can speed up the learning process. The faster the knowledge is absorbed, the greater the dependence on the sources of knowledge becomes.

While it is true that Asia's developing countries differ in economic structure and method of governance, there remain similarities in some respects across the nations. This presents an opportunity for Asian countries to learn from each other. Among their common characteristics, issues such as urbanisation and air pollution in cities as measured by traffic congestion are relevant in the context of promoting low-carbon green growth. For example, the measure of urbanisation between 2005 and 2010 for China was 2.3, for India 2.4, and for ASEAN 2.2 (Kumar, 2012). The creditable efforts of China have included enhancement of organisation and capacity creation for energy and emissions savings; development of energy-saving laws and regulations; analysis of the implications of national energy intensity objectives on sectors as well as annual assessment evaluations; increased public budgets to encourage energy saving; adjustments in tax, price, and financial policies; and elimination of outmoded energy-inefficient production capacity across sectors. Policies towards strengthening forest and wetland restoration and afforestation have been implemented. Also, research on improving carbon sink capacity of forests has been encouraged via financial support from government agencies.

China's afforestation programme can be a good source of learning for Indonesia, which among the Asian emerging economies, has serious problems with deforestation. In fact, Land Use, Land Use Change and Forestry (LULUCF) is at the centre of climate change discussions in Indonesia. Changes in these sectors have been strongly correlated with the country's emissions trajectory. Among the government's several plans, better forest management would be critical in reaping the highest social and environmental benefits from the Reducing Emissions from Deforestation and Forest Degradation plus (REDD+) programme.

The management of forests should be placed in the hands of those who would push for sustainable practices. It may be useful to observe India's forest management initiatives, which aim to strengthen the participation of communities for sustainable use of forests. In this context, the points of Howes and Wyrwoll (2012) are worth noting. They argued that the effective reduction in the level of deforestation in China and India, by use of appropriate blends of market-based and command-and-control instruments, could have been one of the reasons for the increased deforestation elsewhere in the region so as to meet the demand for forest products in the region and beyond. Indonesia would benefit from studying, through a collaborative knowledge partnership, the experiences of China and India in controlling deforestation.

As for air pollution, China has put in place strict regulations for new vehicles to comply with airborne emission standards of Euro II. Furthermore, China promotes the use of mixed-fuel motor vehicles and has popularised the use of gas-burning buses and taxis in cities. It has stepped up resources devoted to coal-liquefaction projects and has encouraged research into developing alternative fuels. To reduce air pollution, India has concentrated its efforts on improving and promoting public transportation, bringing many training programmes to the public as well as using fiscal incentive measures to promote the advantages as well as use of public transportation systems. It also has initiated long-term plans on transport development and urban planning. Like China, India has been supporting R&D programmes on cellulosic extraction of ethanol and butanol from agricultural waste and crop residues.

An important issue within Thailand concerns local governments' lack of knowledge about CDM. There are no clear roadmaps for reducing CO_2 emissions in cities. In this context, Thailand can learn more from the experience of China and India, as both have a large number of CDM projects in Asia.

Thailand needs to link up its plans with co-benefits in activities such as solid waste management at the local level. It can also learn from Japan, which has used a back-casting modelling approach to develop its mid- and long-term roadmap. The city of Yokohama is a good model of a "low-carbon" city (Kainuma, 2012). Just like Indonesia, Thailand also needs support from emerging economies in the region such as China and India as far as collecting data is concerned. It currently needs to establish

baselines for GHG emissions in different sectors and to estimate possible savings at the sub-national level.

These reviews of low-carbon green growth best practices also confirm that there are multiple elements in the way countries are developing their strategies, policies, and measures. Data sourcing and scenario modelling have been cited by policymakers as a constraint in building road maps for low-carbon green growth (ADB 2013a, ADB 2013b, KDI, 2014). In a leadership programme on sustainable development, participants (i.e., mostly policymakers from developing Asia) indicated that many measures and options have not been comprehensively assessed and that further assistance is needed in the conduct of detailed cost-benefit analyses of these policies and practices, and in the identification of relevant entities and stakeholders who may be affected by the measures as part of the monitoring, reporting and verification (MRV) system. A summary of the constraints and needs in capacity building is presented in **Table 5**.

To be effective in this context, planning tools need to be an open-access database of success cases and failed attempts. Sharing of the regions' good practices and options in low-carbon green growth can serve as bases in the preparation of action plans at national and sub-national levels.

Many low- and middle-income countries in Asia do not have enough resources to spend on policy research and development of low-carbon technologies. They also have a chronic shortage of officials and managers with trans-disciplinary skills needed to develop and apply low-carbon policies. Such shortage of human capacity and skilled workforce capable of low-carbon innovations in developing Asian countries underscores the importance of pooling human capital resources regionally. For example, emerging Asian economies with experiences in promoting low-carbon green growth can share their knowledge of policies and practices with other Asian economies. In the end, what is necessary is a permanent regional platform for sharing knowledge and promoting collective learning.

4. Key Policy Actions for Pushing the Regional Cooperation Frontier

4.1. Motivation for Regional Cooperation in the International Context

The emerging economies of Asia alone currently account for nearly 40 percent of GHG emissions, up from 31 percent in 2001. According to several studies (ADB 2009, 2011, 2013; Jotzo, 2010), the cost of adopting climate change is likely to be higher in this region than in other site, including Europe, the United States, the Middle East, and Africa. Given the current emission profile, the latest round of climate change negotiations for the adoption of a comprehensive global treaty will be in force in 2020. Today, Asia remains in a delicate position. Its countries face common technology, finance and capacity building challenges. Asia must be made an integral part of the solution if the global efforts to combat climate change is to succeed.

The proposed framework for regional cooperation in accelerating low-carbon green growth would be in the political interest of all governments in Asia for three reasons. First, a more direct, region-wide push for market-based approaches on energy efficiency, technology, and investment is essential to add credibility to the voluntary pledges and national targets without losing economic competiveness. Second, given the scale of investment required and the deterioration of public finances in many countries, the cooperation, consultation and coordination among governments in this region will make it possible for their countries to leverage on private sector capital. Third, while it will take some time to agree on the details of a global climate deal, it remains important to advance with concrete actions to provide the international community with experience and lessons for increased financial and technical assistance to developing Asia.

4.2. No-Regret Policy Interventions for Improving Regional Cooperation

To capitalise more fully on this opportunity to move regional cooperation ahead, the following policy actions are proposed:

- *Expand the ongoing trade negotiations to include low-carbon goods.* It is high time for the rest of Asia, particularly the rest of the emerging Asian economies,

to take cues from East Asia and form free trade agreements on goods and services that have the potential to contribute significantly to climate change efforts. The removal of tariffs and non-tariffs on four basic clean energy technologies (wind, solar, clean coal and efficient lighting) may be the first steps to take. Liberalising trade and investment across borders in these and other specific goods and services may have implications on the NAMA targets. Other relevant trade concerns that need to be discussed are those related to the definition of products, harmonising classifications and descriptions across countries within the harmonised systems, changes in technology, and perceived impacts on domestic industries.

- *Establish a Regional Low-carbon Fund* that could draw equities from regional sovereign wealth and institutional investors such as pension funds as well as foreign exchange reserves. Multi-lateral and bilateral financial institutions would bit for preferential access to regional low-carbon development packages of their finance mechanisms. Leading regional fund management firms would likewise tender their bids, explaining how they would leverage the mechanisms on offer to create a new fund or strengthen an existing one and generate enhanced investment flows as a result. The credit support package could be opened to preferential bids from end-investors themselves. The fund could work on a long–term cycle, with the right to access public finance mechanisms tendered every five years. In this way, the increased official development assistance that developed countries provide in connection with the Green Climate Fund could also be structured to mobilise a maximum possible amount of low-carbon financing for developing countries in Asia.
- *Start a formal regional public-private dialogue on the role of integrated carbon market*. The dialogue should be started as soon as possible to enable governments, business, and experts to discuss the rules governing emission trading schemes; the role of an integrated carbon market in the low-carbon economy; and the ground rules on how to coordinate for future actions, including the establishment of international procedures, regional frameworks and allowance targets. The dialogue should also tackle the shared level of environmental integrity across emerging schemes; improvements in the

bilateral offset market; how to design approaches for reducing price fluctuations without distorting the markets; and the wise use of revenues from auctioning.

- *Set up low-carbon innovations centres for each sub-region (e.g.,* SAARC, ASEAN, CAREC[1]) to facilitate applied Research, Development and Diffusion programmes on locally relevant low-carbon solutions through open source innovation among academics, businesses, and other actors. A range of activities, shaped by the characteristics of the host region and appropriate to different stages of the technology and market curve, could be utilised by the centres. Funding for the centres would be drawn from regional public funds and philanthropic sources. These centres' main purpose is to support nationally appropriate mitigation actions and align international cooperation with domestic priorities.
- *Launch a regional knowledge platform for capacity building.* This platform should be created as soon as possible to enable progressive economies to engage in a formal dialogue with policymakers, academics, private sector representatives, and international institutes. Suitably set-up as a network of knowledge institutes and as an independent organisation, the platform will establish a learning environment on low-carbon green growth policies and practices. It will also monitor, evaluate and report dynamic policy actions at national, subnational and international levels. This platform will enhance learning, decision-making and management; strengthen government accountability; improve public trust; and enable stakeholder participation. Through widespread consultation, it can also provide decision-makers with policy guidance, good practices, planning tools and data necessary to accelerate low-carbon green growth. Funding for the platform would be drawn from a range of public, private and philanthropic resources.

[1] SAARC – South Asian Association for Regional Cooperation; ASEAN – Association of Southeast Asian Nations; CAREC – Central Asia Regional Economic Cooperation.

4.3. Barriers to Regional Cooperation

The benefits of regional cooperation needs to be balanced against the barriers that have to be overcome. Underpinning many barriers is the question of competitiveness (Bosello, *et al.*, 2003; Lohani, 2008). As noted in Section Two, there are existing trends towards collaboration in the areas of options A, B and C, which are considered to be reflective of market forces. At the heart of any regional cooperation effort and competiveness rationale is some form of relative analysis; that is, any increase in market share is by definition at someone else's expense. While a country or sector may see advantages for itself in a particular form of cooperation, this may be at the expense of another country or firm in the same region. Collaboration in areas that are potentially exploitable by markets are thus prone to concerns about whether countries in the competing trading bloc will gain a greater advantage. In the face of competitiveness in low-carbon technology transfer and innovation, nations now focus on arrangements for intellectual property rights, which seek to regulate the basis on which free trade is conducted.

One closely related type of barrier pertains to those arising from institutional mismatch. Different countries have different structures and priorities for public and private financing. This can mean that governmental involvement is manifested through its support for different types of institutional investments on low-carbon green growth. Hence, what is fundamentally the same financial vehicle could be supported by, for example, public finance in China, or by private finance in China and an international consortium of donors in Indonesia. Concerns about mismatch arise not only because of potential confusion in identifying the right partner but also because one party may feel that other institutional settings give it an advantageous position in terms of exploiting the output. Such mismatch may also exist among national agencies that are involved or responsible for supporting a collaborative network such as low-carbon innovation centres. "Which Ministry is in-charge?" is a common refrain in all directions.

As the support of bilateral and multilateral organisations for low-carbon actions through technical and financial assistance grows, a new set of subsidiary issues is developing around the question of where to locate a particular regional cooperation

facility in a multilateral context. Regional cooperation may also be difficult to sustain in ever-changing political and public financial environments. The longer-term nature of cooperative actions require commitments that last longer than what governments are able to deliver. Under these circumstances, collaborators run the risk of finding that their members had changed priorities and withdrawn support from an initiative. On the other hand, every country is aware that a withdrawal from previously agreed regionally coordinated initiatives comes with a political cost, which can result in a country becoming locked in to a collaborative initiative which it does not wish to continue.

Other known barriers pertain to project-level challenges such as (in ascending order of importance) distance, language, and social capital.

5. Conclusions

This paper conceptualised and mapped a regional cooperation framework on low-carbon green growth in developing Asia. The framework is based on five pillars to address the technology, finance and capacity building needs of developing countries. These pillars, in varying degrees, link domestic actions with international goals on climate change mitigation. Some elements of regional cooperation, particularly market-based ones, will reinforce as well as drive the national and sub-national level actions, while non-market-based ones are framed as "no-regret alternatives" that enhance the public-good nature of current efforts and the aspiration to build knowledge-based economies. Appraising the accountability and assigning the responsibility over this framework is a complex one since countries must interact to find a win-win solution, which implies a situation where each country thinks of both cooperative as well as competitive ways to change so as to maximize the benefits from the identified regional cooperation strategies.

Based on the analysis of current actions and expected needs, this paper also proposed five specific ways to drive regional cooperation. It is hoped that after recognising the potential benefits of such an approach, policy-makers in the region will engage in a wider discussion among themselves, along with the private sector and

civil society operators, on how to build an enabling environment as well as supplement the ongoing actions at national and sub-national level.

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