ARTICLE

*Low Carbon Green Growth as an Inclusive Development Model: Assessing Policy Changes and Initial Lessons from Developing Asia**

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Abstract: *As the world's most populous region and the most vulnerable to climate risks, Asia is at the centre of a paradigm shift towards low carbon green growth. This shift must incorporate economic and social inclusion, and environmental sustainability in the strategic policy making and implementation. Many developing Asian economies have started this paradigm shift, bringing clean energy access to poor, stressing industrial competitiveness, developing green technology markets, and supporting decent job generation. What has been the initial experience with the paradigm shift? What can policy-makers learn from the experience and further advance the policy agenda? How can an action-focussed approach be structured to support the continuing policy learning and advancement? This article paper addresses these questions. Drawing on multi-country studies by a number of Asian national research institutes, the paper proposes a meta-policy analysis approach to support the policy learning. Using this approach, the paper identifies five factors that have clearly contributed to initial successful introduction of the new approach. These include (i) a strong state articulation of low carbon green growth strategy, (ii) decentralized policy making and implementation, (iii) sectoral targets to link energy efficiency improvement with technology innovations, (iv) high levels of private sector participation, and (v) regional cooperation for harnessing financial resources. The article concludes by recommending a regularized process to continue with the meta-analysis approach for policy learning and action.*

Keywords: *low carbon development, Asia, comparative analysis, meta-policy analysis*

Introduction

CLIMATE CHANGE CHALLENGES are fundamentally development concerns. For the Asia-Pacific region, the climate change-cum-development challenges are doubly daunting due to its inter-dependence on natural resources, densely populated coastal areas, and considerable poverty levels. Developing Asia is expected to be

* The views expressed in this paper are of the authors and do not necessarily reflect the views and policies of the organizations they represent.

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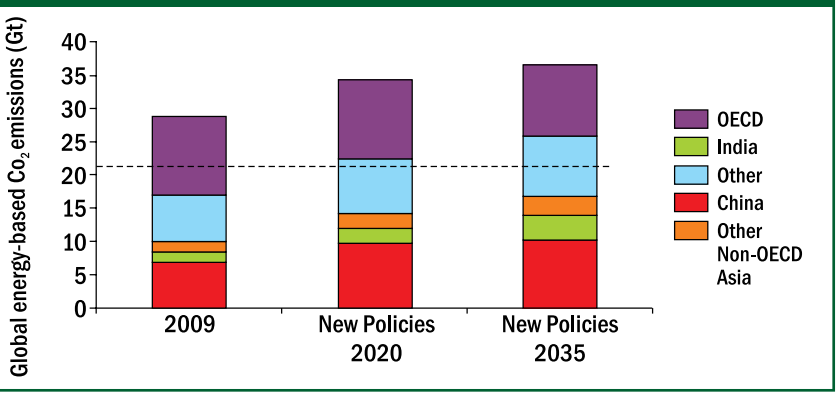
at the centre of the global agenda on low carbon green growth. Asia has much at stake in the fight against climate change it is the world's most populous region and has had high economic growth. Nowhere are production, resource consumption, and emissions growing faster than in developing Asia (ADB 2011, Cline 1992, Howes and Dubes 2012, Ravindranath and Rao 2012, Rose 2009, Thavasi and Ramakrishna 2009, Stiglitz 2010). Figure 1 depicts carbon emissions in 2009 and projected scenarios in 2020 and 2035.

Figure 1: Projected Global Carbon Emission Scenario in 2035



CO_2 = carbon dioxide, Gt = Giga tonne, ppm = parts per million, OECD = Organisation for Economic Co-operation and Development
Note: Other non-OECD Asia refers to developing Asia minus China and India. In 2009, Indonesia, Thailand, and Vietnam jointly comprised 46 per cent of emissions from this group. *Source*: International Energy Agency (2011).

The concept of low carbon green growth underscores the economic dimensions of sustainable growth that is inclusive. Many countries now see opportunities for low carbon energy shifts and improved environmental management that could deliver economic benefits and are introducing the concept in their development planning and implementation. In addition to high profile initiatives in Korea and Japan, other emerging economies, such as China, India, Indonesia, Malaysia, and Thailand as well as Bhutan, Mongolia, and Singapore have registered interest in embarking into low carbon development programmes under the premises of Nationally Appropriate Mitigation Actions (NAMA). A recently published book by the Asian Development Bank (ADB) (ADB–ADBI 2013) and ADB documents (ADB 2009, 2012, 2013) show how the concept has been debated upon and adopted to the central stage of national policy making and development planning in many Asian countries.

Drawing on the outcomes of that research, this article addresses a few follow-on policy-relevant questions. How the initial experience with the paradigm shift has been? What can policy-makers learn from the experience and further advance the policy agenda? How can an action-focused approach be structured to support the continuing policy learning and advancement? This article addresses these questions. Drawing on multi-country studies by a number of Asian national research institutes, the article proposes a meta-analysis approach to support the

policy learning. Using this approach, the article identifies five factors that have clearly contributed to initial successful introduction of the new development approach. This article first presents the meta-policy analysis approach, which is followed by a detailed meta-policy analysis of actions taken by the study countries and highlights key conditions for sustaining the low carbon green growth implementation. The article concludes by recommending a regularized process to continue with the meta-analysis approach for policy learning and action.

Meta-Policy Analysis Approach

A meta-policy analysis approach is similar to the comparative research method. Rather than utilizing statistical analysis to examine variables for comparative analysis or using fuzzy-logic theory, a meta-policy analysis method involves in-depth longitudinal assessments of single instance or group of instances (Plyvbjerg 2001, 2006; Sabatier and Smith 1993). Putting it differently, the meta-policy analysis at national and sub-sectoral levels, combined with a case study analysis, is an investigation of a contemporary phenomenon within its real life context to explore causation in order to find underlying principles (Yin 2008). In the present case, the analysis will seek to understand factors, which catalyse low carbon green growth. Through employing this meta-policy analysis approach, we endeavoured to provide what methodological theory called a detailed examination of an aspect of a transformation process to develop or test explanations that may be generalizable to other transformational events (George and Bennett 2004).

The meta-policy analysis is designed after the Inter-governmental Panel on Climate Change (IPCC) approach used to prepare its Assessment Reports. The IPCC bases its assessment on published literature, which includes peer-reviewed and non-peer reviewed knowledge sources (IPCC 2007). Thousands of scientists and other experts contribute to writing and reviewing the reports, which are then received by governments. For this meta-policy analysis, an Asian network of national research institutes was established. This research network is a convenient framework for combining knowledge from wide range of sources. It had the goals of (*i*) coordinated exploration of past policy actions and possible future trajectories, (*ii*) development of insights into key questions of low carbon green growth policy formations, and (*iii*) prioritization of key factors in order to enhance our ability to identify robust policy changes taking place at different levels of the government. By this network process, we coordinated several assumptions related to low carbon green growth within the context of developing Asia and introduced feedbacks that are absent in conclusions available in peer-reviewed publications. This type of hybrid meta-policy analysis is needed in the all-too common situation when researchers have difficulties in summarizing overall results of several studies on public policy (Barret 2005).

Our intent was to assess the current policy changes towards a new paradigm rather than test previous development theory. Consequently, insights were

extracted from on-going research studies carried out by national research institutes and inductively cobbled into the framework. In inductive models, some sort of cognitive framework is needed to guide the search for causal factors (Casillas and Kammen 2012, Never and Betz 2014). Accordingly, we selected adoption of inclusive growth and sustainability perspective as a cognitive framework for conducting our analysis. Bowen and Ranger (2012), Howes and Wyroll (2012), Salim (2012), Kumar (2012), Wyes and Lewandowki (2012), and Zhu (2012) posited that access to low carbon energy supply and use occurs within a socio-economic system as comprising a seamless web of technological, social, political, and economic casual factors that support the occurrence of a new development regime. This perspective on low carbon green growth is appealing because it integrates effectively with a number of well-regarded public policy theories. A key promise that the approach agree on is that successful transformation strategies are not arbitrarily designed and built; they must be designed and built for and into the societal development.

When the theory of low carbon development is influencing inclusive growth, there might be a set of necessary public policies that support the new development regime (Bowen and Stern 2010, Murshed 2009). Accordingly, the multi-country case studies attempt to track the evolution of low carbon green growth in China, India, Indonesia, Thailand, Vietnam, Singapore, and compare it with Korea and Japan for significant policy influences that supported the new development paradigm in these countries. The appeal of choosing these countries for comparative purposes stems from the markedly similar development paths of their economies and structural transformation taking place at sectoral and sub-national levels. All countries have a long history of fossil fuel dependent growth, but now they have pressure to make their future growth more inclusive and sustainable. All countries rely on imported energy resources and have ambitious plans to reduce carbon emissions, expand their renewable energy sectors, and improve energy efficiency and believe in regional cooperation as the best way to tackle climate change and accelerate green growth (Garnaut 2011, Howes and Wyroll 2012).

The policies we included for meta-analysis consist of national development plans, sectoral plans and targets for energy-efficiency improvement and renewable energy mix, policies that support market capitalization, local government actions, private sector development, and economic integration. Since GHG reporting remains sparse in the region in assessing the policy impacts on GHG emissions, we studied in detail the National Communications (NC) to United Nations Framework Convention on Climate Change (UNFCCC). In both the initial examination of emission profile and subsequent investigation into policies that effect changes, we organized policy dialogues involving national research institutes, senior government officials, and other stakeholders to correct any endogenous effects and include feedback.

Analysis on Policy Factors Effecting Low Carbon Green Growth in Developing Asia

In this section, we compare and contrast the results of meta-policy analysis to highlight factors that drive low carbon green growth in the studied countries. This in turn provides an opportunity for distilling insights for policy changes by policy-advisors and policy-makers in different countries who plan to move forward with their low carbon development agenda.

The guiding hand of the governments in supporting national development goals

The governments of the studied countries have a long-standing history of strong centrally led economic, planning. Those economic plans aim to harness environmental, economic and social benefits. Over the period 2007–2012, all the studied countries incorporated emission reduction strategies in their national development plans. In the lead-up to the UNFCCC Summit in Copenhagen in 2009, many developing countries for the first time articulated a specific target for curbing carbon emissions (Zhou *et al.* 2010). Apart from the National Climate Change Programme, China's 12th Five Year Plan laid out a series of relevant climate change mitigation targets up to 2015. Additionally, the government aims to reduce nitrous oxide emissions by 10 per cent by installing extra capacity of non-fossil fuel power generation, including 70 GW wind, 15 GW solar, 120 GW hydropower, and 40 GW nuclear, among other quantitative targets.

India launched the National Action Plan on Climate Change in June 2008, with eight missions covering mitigation issues prior to its voluntary Copenhagen pledge of reducing emissions intensity by 20–25 per cent of 2005 levels by 2020. The National Solar Mission aims at generating 20,000 megawatts (MW) of energy from the sun by 2022 and making India a global leader in solar energy deployment through the extension of electricity access to poor. Other targets relating to this objective include 2 GW of offgrid solar plants, 20 million square metres of solar collectors, and 20 million solar lighting systems distributed in rural areas, thus saving about 1 billion litre of kerosene every year, which is about 8–10 per cent of the country's total annual consumption (Mathur 2012). India's 12th Five-Year Plan is also expected to align the planning process with these targets, and for the first time included a specific chapter on climate change.

Indonesia has voluntarily pledged to reduce its emissions by 26 per cent compared with business as usual by 2020, and up to 41 per cent with international support. At present, land use and land-use change, particularly forestry and peatland, comprise 85 per cent of national carbon emissions. The country's National Action Plan addressing Climate Change articulated through a Presidential decree issued in 2010 includes low carbon actions in its Medium-Term Development Plan, 2010–14 and supports activities including the development of data, information and communication, strengthening of institutional capacity, and science and technology development. While Thailand has not specifically articulated a low

carbon green growth strategy through Royal declaration, its Energy Conservation Programme and the 15-Year Renewable Energy Development Plan lay out targets that clearly align with low carbon pathways (Chotichanathawewong and Natapol 2012). According to these programmes, 44 per cent of the country's savings are intended to be found in the transport sector, followed by industry (37 per cent) and buildings (17 per cent).

With a target of 5.6 GW of renewable energy, 3.7 GW is intended from biomass, 0.8 GW from wind, 0.5 GW from solar, 0.32 GW from hydropower, and 0.16 GW from methane in municipal waste, Vietnam has developed the 'National Target Program to Respond to Climate Change', which assigns ministries, sectors, provinces, and cities the task of developing and implementing plans to reduce carbon emissions, assess climate change impacts, identify responses, and integrate climate change concerns into strategies, programmes, and plans. Vietnam's laws and policies directed towards energy efficiency, conservation, and renewable energy further align its development plans with a low carbon path. The inception of South Korea's Green Growth programme can be traced to green stimulus packages and the 5th Year National Action Plan in July 2009. It put forth the 4th Comprehensive National Action Plan for Climate Change 2008–12, the Five Year National Action Plan for Green Growth, and the Basic Law on Low Carbon and Green Growth in January 2010. Singapore launched the National Climate Change Strategy in March 2008 and the implementation of the Sustainable Singapore Blueprint started in April 2009 (Doshi 2012).

In accordance with the Copenhagen Accord, Japan has a target to reduce GHG emissions by 25 per cent, compared to the 1990 level, by 2020, on the premise that a fair and effective international framework, in which all major economies participate, is established and ambitious targets agreed by the major economies. In November 2009, Japan also announced that it would aim at 80 per cent reduction in its emissions by 2050 and support a target for halving global emissions by 2050 (Kainuma 2012).

Table 1 summarizes the targets of the major Asian economies under study across four major indicators — carbon emissions, renewable energy, energy efficiency, and deforestation. Across all countries under study, within the energy sector, energy efficiency and renewable energy are the two key options to address energy security and economic growth, as well as climate change. Further, given the relatively low base of renewable energy installation and the challenges of higher up-front investment costs, the plans to reduce energy intensity and cut the share of fossil fuels in countries, such as China, India, Thailand, and the others in Table 1 are fairly ambitious. Most of the countries also have targets for increased forest cover. Although these low carbon development plans strategies are very different in-terms of scope, the objectives are determined by governments; all of them are best judged in terms of achieving one of the three co-benefits of environment, economic, and social.

Table 1: Nationally Appropriate Climate Change Mitigation Targets of Major Asian Economies

Country	Emission Targets	Renewable Energy Targets	Energy Efficiency	Deforestation
China	Reduce 40% to 45% emissions intensity (2005–20) Reduce 17% emissions intensity (2010–15)	11.4% by 2015 15% by 2020 up from 8.3% in 2010	Reduce 16% energy intensity (2010–2015)	Increase forest cover by 40 million ha by 2020 from 2005 level Increase forest cover to 21.7% by 2015, from 20.36% in 2010
India	Reduce 20% to 25% emissions intensity (2005–20)	15% by 2020 up from ~ 4% (2010) 20,000 MW solar by 2020	10,000 MW energy savings by 2020	Increase forest cover by 20 million ha by 2020 from 2010 level
Indonesia	Reduce 26% to 41% emissions below BAU	15% by 2025 (incl. nuclear)	1% average annual reduction in energy intensity (2005–2025) Reduced elasticity of electricity/GDP to <1 (2025)	Forestry as net carbon sink by 2030
Thailand	Reduce 30% energy emissions below BAU	20.3% by 2022	8% reduction in energy intensity (2005–2015), 15% reduction (2005–2020) 25% reduction (2005–2030)	Forest cover to be 40% of total land mass (target introduced in 1991, 2010 level is 37%, up from 25% in 1998)
Vietnam	–	5.6% by 2020 9.4% by 2030 up from 3% (2010)	Reduction in elasticity of electricity/GDP from 2 (2010) to 1.5 (2015), to 1 (2020)	Increase forest cover to 16.2 million ha in 2020 from 14.3 million ha (2010)
Japan	Conditional reduction of 25% emissions below 2000 levels	16.0 TWh by 2014	30% reduction in energy intensity (2006–2030)	–
Korea	30% reduced emissions below BAU in 2030	6.08% by 2020 up from 2.7% in 2009	–	–

BAU = business as usual, GDP = gross domestic product, ha = hectare, MW = megawatt, TWh = terawatt-hour.

Notes: 1. All emissions targets by 2020 unless stated otherwise.

2. Emissions intensity refers to the volume of carbon emissions produced per unit of GDP.

3. Energy intensity refers to the volume of energy consumed per unit of GDP.

4. The absence of specific targets for particular issues does not indicate an absence of policy, rather, the absence of a stated national target. For example, the Government of the Republic of Korea is implementing a large number of policy actions relating to energy efficiency, but does not have a specific national target.

Sources: Howes and Dobes (2012), Chotichanathanwewong and Natapol (2012), Mathur (2012), Patunru (2012), Toan (2012), and Zhu (2012).

Decentralization of energy policy making and renewable energy uptake

It is crucial that low carbon growth identifies priority areas of action and champion on key strategies to bring inclusiveness. For decades, expansion of renewable energy programmes has been perceived as a strategic necessity for enhancing domestic energy security in developing countries of Asia. Extending national grid infrastructure to remote areas is proving to be a difficult, costly, and time-intensive process in many countries, perpetuating poverty and health damages from traditional biomass cooking practices. Decentralized, offgrid renewable technologies, such as small-scale solar and biogas, present a very real opportunity for remote communities to share the rising living standards being experienced elsewhere, and further promote national economic expansion.

The studied countries have put in place measures to enhance the share of renewables in their energy mix by decentralization of energy policy making. While this may have been driven primarily by the desire to enhance energy diversification at the national level, this is increasingly being viewed as a catalyst for the creation of markets at the local level that can provide opportunities for employment, new industrial growth, and increase in economic activity and trade.

China, through the Renewable Energy Law and other policies that focus on giving more decision-making power to provincial governments, has been able to increase the use of renewables massively. It contributed for substantial emissions reduction during 2007–10 (Zhu 2012). The 11th Five-Year Plan provided a major thrust to resource diversification and resulted in enhanced wind, hydro, and nuclear capacities. A significant number of large hydropower projects were constructed in 2010, the capacity of small hydro power in rural areas was stepped up, and the Ministry of Water Resources and the National Development and Reform Commission proceeded with the checking and rectification of 5,200 problematic hydro power stations and strengthened the construction and management of small hydro power stations. As a result, the installed capacity of hydropower exceeded 200 GW and the grid-connected operational capacity of wind power surpassed 30 GW. The 12th Plan has put in place a target to increase the share of renewable energy in primary energy consumption from 8.3 per cent to 11.4 per cent by 2015 and aims for 15 per cent non-fossil energy consumption by 2020. With the steady development of the solar photovoltaic (PV) market, the PV industry has seen continuous development of off grid, low carbon energy supply in China. Driven by the development of international as well as domestic markets, the price of solar generation has been decreasing, and in 2010 the newly increased installed capacity of generation units in the global PV market grew at about 120 per cent, reaching above 17 GW. In September 2010, the Notice on Strengthening the Management of Golden Sun Project and Solar Photovoltaic Demonstration projects in buildings was issued. With regard to solar thermal applications, a subsidized programme exists for rural families to purchase solar products, which has resulted in the installation of 168 million square metres of solar heaters, substituting about 22 million tonnes of fossil fuel (Zhu 2012). Biomass energy has also enjoyed

diversified development in China. By 2010, China had 6.7 GW of biomass-based generation capacity, including bagasse power generation, straw, and forestry-based power generation and urban waste, biogas, and land-fill gas power.

A comparison of several policy instruments employed to enhance the uptake renewable energy at country level are summarized in Table 2. Renewable energy has been recognized as an important element in India's energy mix for over four decades, and the country has among the world's largest programmes for renewables. Grid-connected renewable power contributed to about 19,974 MW of electricity in March 2011, accounting for about 10 per cent of India's installed generation capacity (Ravindranath and Rao 2012). Having initiated its wind power programme in the early 1980s, India had a capacity of 14,158 MW in 2011, with many leading states, where decentralized energy planning enhanced the access to clean energy to off-grid communities (Attridge *et al.* 2012).

In Thailand, energy efficiency and renewable energy development have received an impetus with the 15-Year Renewable Energy Development Plan, the 20-Year Energy Conservation Plan, and the Power Development Plan 2010. The challenge of reducing carbon emissions at local is reflected in the, 15-Year Renewable Energy Development Plan, which stipulated Independent Power Producers (IPP), such ethanol, biodiesel, solar, wind, as hydro, biomass, biogas, waste heat, and municipal waste operators to serve the consumers directly based on demand

Table 2: Comparison of the Current Application of Various Policy Instruments for Renewable Energy Uptake

Country	Feed-in tariff	Renewable energy certificates	Trading markets for energy efficiency	Renewable quotas/portfolio standards	Mandated biofuel blending	Fuel economy/vehicle emissions standards	Capital subsidy, grants, or rebates	Tax incentives	Public R&D institutions	Public investment, loans, or grants
China	Wind, solar, biomass		●	●	●	●	●	●	●	●
India	Wind, solar, biomass, small-hydro	●	●	●	●	●	●	●	●	●
Indonesia	Renewable (including geothermal)				●	●	●	●	●	●
Thailand	Wind, solar, biomass/ gas, waste				●	●	●	●	●	●
Vietnam	–					●	●	●	●	●

factors. With the successful implementation of the plan, a GHG reduction of about 42 $MtCO_2$ eq. is expected by 2022 (Chotichanathawewong and Natapol 2012).

Vietnam's National Strategy for Energy Development until 2020 and vision towards 2050 aims to develop energy quickly and sustainably in close association with the provincial-level socioeconomic development strategies, in parallel with diversifying energy sources and applying energy-saving technologies. Indonesia also plans for increased energy diversification at the local level, with emphasis on optimization of biomass resource use.

Targeted sectoral actions to link energy-efficiency improvement with technology innovations

The meta-policy analysis clearly indicates that the countries under the study also put in place sector level development policies that have clear economic and social co-benefits, and have helped to improve efficiencies and bring emission reductions. Energy efficiency benchmarking was launched in cement, steel, and chemical industries in China and became compulsory for all heavy industries. In the power and industry sectors, efforts have been made across most of the studied countries toward the diffusion of low carbon technologies. These include ultra-super critical thermal power plant technology, dry quenching technology, low-temperature waste heat power generation, and regenerative combustion technology. Both China and India, for instance, have made significant improvements in energy intensity in certain sub-sectors, such as cement and steel, with some plants/units already having state-of-the-art technology (Asuka 2012). China and India have also been eliminating small out-dated and inefficient production capacities across electricity, iron and steel, cement, glass, pulp making, and other sectors.

Many countries have also initiated measures to enhance energy conservation and integrate renewables in the housing and buildings sector. The 11th Plan of China had a target of more than 90 per cent of new buildings to be constructed under mandatory standards for energy saving. Large public buildings integrated renewables into their construction planning and energy conservation projects have been promoted for heating and air conditioning systems in hotels and commercial buildings. Similarly, in India, the Ministry of New and Renewable Energy has initiated several programmes focusing on integrating renewable energy use in buildings. An Energy Conservation Building Code was launched in May 2007, which addresses the design of new large commercial buildings to optimize buildings' energy demand. All buildings with a built-up area above 20,000 square metres are audited by the Ministry's Environmental Appraisal Committees and the State Environmental Appraisal Committees for efficiency improvement. More recently, India put forward a Mission on Sustainable Habitat within its National Action Plan on Climate Change, of which green buildings are an important element.

The transportation sector has played a key role in China's development process, but has also put increasing pressure on oil imports and emissions. The Government of China has supported rail development and accelerated the construction of

passenger-dedicated lines and inter-urban railways, apart from improving highway development and water transportation simultaneously. During the 11th Plan, the Ministry of Transport launched eight major energy conservation projects in companies, test units for fuel consumption access and withdrawal, energy-efficient driving, test units for energy saving in transportation with dumping trailers, construction of a public travel traffic information service system, and construction of energy saving ports. Significant progress has been made in the diffusion of energy-efficient and new energy automobiles. In Thailand, policies exist on waste, especially in Bangkok and other large cities. In India, the National Mission for Sustainable Habitat aims to develop a comprehensive approach to managing water, solid waste, and wastewater and to tap the potential for recycling, reuse, and energy creation in urban centres. Other initiatives, such as the Programme for Energy Recovery from Urban and Industrial Waste, aim to tap power generation potential from industrial waste in India.

Many countries under study have made commitments to emission reduction policies in forestry. The National Mission for a Green India, under India's National Action Plan on Climate Change, aims to increase forest cover on 10 million hectares of land and to increase CO_2 sequestration in forests by 50–60 Mt per year by 2020. The Government of India has allocated funds to support programmes for the conservation, regeneration, and management of existing forests and wildlife habitats. Similarly, China has a target to increase forest cover by 40 million hectares and forest stock volume by 1.3 billion cubic metres by 2020 from the 2005 level (Zhu 2012). Indonesia has taken actions that help maintain existing forest cover, restore lost carbon stocks from degraded or cleared forests, and create new forest areas to increase carbon sinks.

Apart from sectoral-level targets, China and India have also embarked on sub-national and local initiatives to enhance efficiency and reduce emissions. In 2010, the National Development and Reform Commission of China awarded 108 cities the title of National Green Energy Demonstration County. Subsidies are provided for the construction of green energy demonstration cities to facilitate the development and use of renewable energy, and establish a service system for rural energy. In 2008, the Indian state of Himachal Pradesh introduced a voluntary green tax on vehicle users to create a fund for combating climate change — one of the first of its kind at state level. The state government also announced an integrated energy and environment plan, through which the State aims to turn carbon neutral. The State of Gujarat has similarly undertaken innovative measures to bring in sustainable and greener development by enhancing the exploitation of clean and efficient options. For example, a multi-benefit pilot project generating 1 MW electricity from solar panels atop the Narmada branch canal was set up in 2011. Solar panels have been fitted over a 750-metre stretch on the Sanand-Kadi Narmada branch canal to generate 1.6 million units of clean electricity annually (Betz 2012). Besides producing clean energy without causing any pollution, the solar panels would spare a large amount of land otherwise required, if the solar

power project were land-based. It is estimated that the project could prevent the evaporation of about 9 million litres of water annually as the canal will remain covered — a social co-benefit. Japan has already undertaken initiatives to curb emissions, and has extensive experience that can be spread far and wide The Sustainable Shiga Initiative, Low Carbon Kyoto, Carbon-Minus Tokyo, and the Clean Energy Demonstration Town: Kuzumaki Town are among the initiatives taken up by Japan at the local level (Kainuma 2012).

Fixing the sectoral targets also induced national innovation systems and the advent of low carbon technologies. In 2011, China has the third-largest number of green patents in the world after USA and the European Union (Ramanathan 2012). The Government of Korea established the Presidential Committee on Green Growth (PCGG) in January 2009 by a Presidential Decree that led to a strategy for the development and commercialization of 27 core low carbon green technologies (Kang 2012). The Green Technology Network integrates the existing low carbon technology information systems of eight public institutes and provides practical information on 27 core technologies in terms of basic technical information, industry and market analysis, policy actions, R&D progress, road map, etc. The government has also set up a step-by-step investment plan and strategy for these technologies based on current investment priorities, the level of technology progress, and prospects of commercialization. Simultaneously, the government has worked on expanding infrastructure to facilitate commercialization of developed technology.

High Levels of Private Sector Participation

The economy-wide nature of low carbon development and sector-wise target, necessitate the engagement of key stakeholders, such as a private sector. The private sector is made up of local and foreign-owned enterprises operating at different scales, from large corporations, to small and medium enterprises (SMEs), to microenterprises operating in the informal sector. Private actors in the studied countries currently play a role in all of the sectors identified above as critical to emission reduction.

Industry accounted for 70 per cent of energy consumption in China in 2006 (Walsh *et al.* 2011). So, the government launched the 1,000 Energy Consuming Enterprise Programme across nine sectors. With the aim of changing to best available technologies, this initiative saved 150 million tonnes of oil equivalent during the 2007–12 period (Zhu 2012). In 2011, China led the world in renewable energy investment and in 2010 accounted for half of all global manufacturing of solar modules and wind turbines, with the majority of solar technology production made for export. The government has frequently articulated its goal for Chinese companies to dominate clean energy markets and demonstrated its sense of purpose through ambitious policies. Elsewhere, India is now ranked 8th globally in clean energy investment, and Indonesia had the fourth largest growth in this area

from 2005 to 2010 (Choudhury 2012). Whether for export or to meet domestic expansion, growth of private sector in the renewable energy sector presents an important stimulus for innovations in domestic manufacturing in particular, and economic growth more generally. At the domestic level, proliferation of private sector operators as independent renewable energy producer presented a significant opportunity for increasing access to modern energy services to the estimated 1.5 million people in the studied countries over the period of 2001–2010 (REN 2012).

In China, India, Indonesia, and Thailand, the private sector is often seen as having significant resources and capacity for investment, and may also have high levels of efficiency, managerial capability, and operational power, which can be harnessed to achieve low carbon green growth goals. In China, The National Development Reform Commission and the Ministry of Finance provide subsidies for energy efficiency retrofit market from June 2010, offering funding to Energy Service Companies (ESCOs) to execute energy management contracts. Bureau of Energy efficiency (BEE) in India has undertaken many projects to create a framework at the national level for the accreditation of ESCOs. BEE has shortlisted about 35 ESCOS that would help state governments in taking up energy efficiency projects of public sector enterprises.

In Korea, the government introduced the Green Certificate System in 2009. This acts as a supporting mechanism that allows business groups not only to obtain easier access to funds for low carbon technology development, and provides tax breaks, but also incorporates tools and measures to help private enterprises throughout the business stages, including public financing, research and development, marketing, commercialization, and distribution of new technologies. Other types of incentive systems for the private sector, which have been widely practised in the studied countries are summarized in Table 3.

Table 3: Types of Incentive Systems for Engaging the Private Sector in Low-carbon Green Growth Efforts

Types of Incentive (Country)	Beneficiary Private Sector
Pioneer status and tax allowance for 100% of statutory income for 10 years; projects must be implemented within a year of receiving the incentive (China)	Companies implementing energy conservation projects
100% tax allowance on capital expenditure within first 5 years of project (India)	Companies generating renewable energy for their own consumption
Tax exemption on 100% of additional capital expenditure for green buildings and forest conservation (Indonesia)	For enterprises involved in green buildings and forestry
Import duty and sales tax exemptions on solar PV and solar heating equipment (Thailand)	Solar PV system equipment retailers
Sales tax exemption on energy-efficient products (Vietnam)	Full exemption for local manufactures of energy-efficient goods; partial exemption for imported equipment distributors
100% import duty exemptions and 50% excise duty exemption (Singapore)	Hybrid and electric cars and motorbikes distributors
Exemptions on income tax from sales of Certified Emission Reduction (CER) (Korea)	Clean Development Mechanism (CDM) project developers

Nevertheless, early stakeholder engagement is particularly important for active participation of the private sector in setting the objectives and determining the criteria for inclusive growth (Breuer 2011, Choudhury 2012, Friel 2009). Involving private sector stakeholders in the sectoral target settings will ensure the sustainability of low carbon development efforts made by the governments and maximize the co-benefits.

Regional cooperation for harnessing financial resources at lower cost

The success of implementing low carbon green growth strategies very much depends upon strengthening finance and investment conditions that also maximize social co-benefits. An investment of more than $6 trillion will be needed in the region by 2030 in the energy sector alone for making the shift (Hongo 2012) to 450 ppm CO_2 levels. Sources of international financing and financing instruments currently used in the study countries are summarized in Table 4. These categories are sometimes overlapping across borders and changing over time. For e.g., countries such as China and India currently focused on investing in clean energy access domestically, also invest in other countries like Thailand and Vietnam.

Table 4: Source of International Financing and Financing Instruments that Supports Low-carbon Green Growth

	Source	Grants/credits	Concessionary loans	Market-rate loans	Credit line	Credit gurantee	Risk insurance	Equity	Carbon financing	Subsidy	Feed-in tariff	Technical assistance
International	MDB	●	●	●	●	●	●	●	●			●
	Bilateral Development Agencies	●	●	●	●				●			●
	Guarantee Agencies			●			●					●
	International Banks			●				●	●			
	Investment Funds							●	●			
	Private Investors							●	●			●
National	Central and State Governments	●	●					●		●	●	
	National Development Banks		●	●	●	●						●
	Rural Energy Funds	●								●		●
	Foundations	●						●	●			
	Micro-Finance			●								
	Local Banks			●								

Within each broad category, several different types of international financing instruments that support low carbon growth exist. Multilateral development sources include The World Bank and the Asian Development Bank. Bilateral sources are primarily official development assistance provided by the Development Assistance Committee member countries such as Japan and Korea. Political risk insurers, such as Multilateral Investment Guarantee Agency (MIGA) and ADB's Asia Pacific Carbon Fund, have a mission to promote foreign direct investment in the studied countries by insuring private investor's project risks. Obtaining such risk insurance is having leveraging effects on countries, such as China and India (Kim 2012). In other developing countries, such as Indonesia and Vietnam, such risk insurance are also accompanied by international technical assistance programmes. Carbon finance also offers the studied countries a possible source of income for clean energy access projects that also help to reduce GHG emissions. Up to 2011, 15 Clean Development Mechanism (CDM) projects or 0.7% of the total, have been designed to increase energy access for poor households in China, India, and Indonesia (Sachs and Someshwar 2012).

Filling the financing gap will require integration of carbon markets. CDM, among other carbon market mechanisms, can be termed a success but it is still very uncertain whether it can deliver the required financial resources due to oversupply and low demand caused by international and national policies (Ninomiya 2011, Rhee *et al.* 2012). Financing from developed countries through such innovative mechanisms, such as the Japan Bilateral Offset Credit Mechanism (BOCM), will be key as it is also in the global community's interest for developing Asia to cut emissions (Sudo 2012). From the perspective of equity and historical responsibility, developed countries should show leadership and share responsibility in filling the significant financing gap. This must be done in addition to official development assistance, if inclusive growth and co-benefit objectives are not to suffer (Kawai and Lee 2010).

There are already a few low carbon energy collaboration programmes in Asia that have been working reasonably well. For example, Japan has established energy collaborative projects, such as the Energy Silk Road project involving China, Turkmenistan, and the Trans ASEAN gas pipeline network. Lao PDR is trading its surplus renewable energy to its neighbour Thailand, offsetting its emission in a win-win strategy. Bhutan trades surplus energy with India. Myanmar and Thailand have been cooperating on natural gas exports. Developing harmonized standards and synchronization of power-grids will further integrate energy and carbon markets in the region.

However, shortage of R&D capacity and skilled workforces capable of low carbon innovations in developing Asia emphasizes the importance of regional cooperation in pooling human capital resources through increasing the mobility of skilled personnel across countries (Brastasida 2011, Dubochet 2011, Lohani 2008, Foxon and Pearson 2008). In this context, establishment of the Global

Green Growth Institute (GGGI) in 2010 and the initiation of the Low Carbon Asia Research Network (LoCARNet) in 2012 by the Government of Japan is noteworthy.

Regionally coordinated actions would be in the political interest of all governments for the following three reasons. First, a more direct, region-wide push on energy efficiency, technology, investment, and deforestation is essential to add credibility to the voluntary NAMA pledges and national targets without losing economic competitiveness. Second, given the scale of investment required and the deterioration of public finances in many countries, cooperation, consultation, and coordination among governments of this region can leverage private sector capital. Third, because it will take time to agree on the details to implement a global climate deal, it is important to advance with concrete actions to provide the international community with experience and lessons for increased financial and technical assistance to the fast growing economies of Asia.

Lessons learned for up-scaling of low carbon green growth policy actions in developing Asia

This section draws from the country cases to explicate a framework that might allow analysts to predict the requisite policy changes to catalyse low carbon green growth. Five dominant factors appear to be at the core of support for low carbon development in developing Asia. As Table 5 depicts, each of the policy factor elements played a highly influential role in allowing low carbon energy systems to develop in emerging economies of Asia. In all the countries, development of

Table 5: Policy Factor Theory of Low-carbon Green Growth

Factor	Examples
A strong state articulation of low-carbon green growth strategy with focus on co-benefits	China has committed to low-carbon green growth in its 12th Five Year Plan, with the aim of attaining environmental co-benefits and economic competiveness
Decentralized policy making and implementation	Indian government sees a strategic link between economic growth, social development, and green house reductions through decentralized renewable energy planning
Sectoral targets to link energy efficiency improvement with technology innovations	Indonesia's low-carbon green growth policies have been important engine for restoration of forests and the emergence of internationally competitive Small and Medium Enterprise (SME) sector
High levels of private sector activism	Korea has adopted a low-carbon green growth strategy to drive competitiveness through development and use of advanced technologies by the private sector
Regional cooperation for harnessing financial resources	Thailand and Lao DPR are jointly mobilizing investment for cross border infrastructure that distributes renewable energy at lower cost, alleviate poverty, and support entrepreneurial innovation for integrated low-carbon markets

renewable and energy efficiency measures was driven by government funding and supported by private sector with unlimited harnessing potentials of regional cooperation. The governments are employing targeted approaches to achieve the co-benefit objectives in a strategic way low carbon green growth also embellishes the studied countries' efforts to provide secured clean energy to poor. Low carbon green growth strategies were also insulated from political challenge by including them in national development plans. Civic support is also invasive in many countries (Mohanty 2012, GGGI 2012).

What do these five factors mean for the future of low carbon green growth paradigm shift in the studied countries? As Figure 1 indicates, at the global level total carbon emissions show a continuous rise. Under a business as usual (BAU) scenario, even if today's developed economies reduce their emissions to zero, that would be insufficient to achieve 450 ppm — equivalent to a trajectory of annual emissions falling to 21.7 Gt of CO_2 equivalent. That means, currently fast growing economies of Asia must also play a key role in emissions reduction. In all the countries studied, there is potential for large-scale reductions in GHG emissions against BAU trajectories simultaneously maintaining economic growth targets (ADB–ADBI, 2013). Many studies (Asuka 2012, BNEF 2012, Jotzo 2010, Kang and Kang 2011, PWC 2008, Stern 2007, Matsuoka *et al.* 2008) estimate that the world has only until 2017 to shift to a 450 ppm trajectory before a lock-in effect of existing infrastructure requires that all investments made between 2020 and 2035 must be based on zero emission options (Barber 2010, Frankel 2009, Rang 2010, Winkler *et al.* 2007). However, as the meta-policy analysis indicates, achieving these reductions will require up-scaling of the policy actions across sectors, including energy supply and demand, land-use, forestry, urban development and planning, and sustainable transport. Most of these interventions such as increasing cogeneration, improving vehicle efficiency, and reducing electricity system losses will pay for themselves. Nevertheless, a more ambitious regional action is still required.

Scaling up many of the actions, discussed in the previous section, and translating them into a substantial contribution to global climate change mitigation will require stronger efforts at the regional level to bring down technology costs, support the development of new technologies to scale up private sector financing, and provide climate finance that has co-benefits. The regional trading systems can have a significant influence on low carbon green growth, enabling or obstructing the flow of low carbon goods, services, technologies, and investments (Mikic 2010). Free trade agreements that liberalize trade in low carbon goods and services, and investment in low carbon projects is necessary. Kalirajan (2012) found that trade liberalization could result in a 7–13 per cent increase in the trade volume of low carbon technologies, 8–10 per cent reduction in poverty, as well as 8–11 per cent reduction carbon emissions. It is essential that such regional cooperation efforts are supported by targeted capacity-building programmes to share knowledge on good policy practices.

Summary

Recent years have seen a growing number of studies on the need for and the macroeconomic impacts of low carbon green growth. These studies, well-meaning and valuable as they are, are heterogeneous in terms of both methodological characteristics and policy findings, and thus are limiting their value for the purpose of policy learning. In this article, we presented a meta-policy analysis approach providing descriptive assessment of policy actions taken at different levels of governments in Asia, based on the synthesis of a rich literature provided by a network of national research institutes. The meta-analysis takes account of actions taken by seven fast-growing economies of Asia and examines the policy factors driving the changes for low carbon green growth. The results illustrated how, despite having very low per capita GHG emissions, many developing countries of Asia are still making substantial reductions in GHG emissions and energy use with investments, that in many cases, pay the costs themselves. The meta-analysis demonstrates that it is possible to integrate low carbon green growth objectives into sectoral plans rather than treating climate change as add-on to be solved through stand alone policies. Making low carbon development an agenda of the economy rather than an issue concerning any particular ministry, is a key lesson coming from this five-country study, and one that could have lasting consequences in terms of government coordination on climate change policy in the countries studied. Central to this is the strong priority to private sector participation and regional cooperation for scaling up of current efforts to attain full benefits of low carbon green growth. Based on the country case studies analysed in this article, transformative policy changes (up scaling of factor conditions to harness the co-benefits) and funding for readiness activeness (economy wide and sector-specific low carbon technology interventions) are proposed as high priorities for regionally coordinated collaborative actions among the studied countries, as they are likely to achieve the greatest returns at lower cost.

The meta-analysis approach presented in this article, while modelled after the IPCC process of preparing assessment reports, has strong points related to its ability to include qualitative analysis, case studies, and studies in local languages that are not generally reported by the global community. The meta-analysis takes these studies and analysis into account to identify valuable factors that affect policy changes. This approach to assess policy actions through a network of national research institutes in Asia is completely transparent and has the benefit of adopting a developmental perspective to climate change responses. This network is composed of researchers who contribute directly to development of low carbon and green growth policy, and are involved in a policy-making process and contribute their knowledge to decision making and policy planning. Through this network, it is expected that knowledge and experience are shared, research cooperation related to low carbon growth is promoted, and inputs to policy-making are provided. Most importantly, this meta-analysis approach also helps demystify

the relationship between findings in primary studies and their methodological characteristics. Hence, it is recommended to regularize the process for continued policy learning and action.

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