

Green Growth and Low-carbon Development in Northeast Asia: An Introduction

Akihisa MORI

Background

During periods of rapid economic growth, many Asian countries have suffered from various types of environmental degradation, ranging from pollution of the local air, water, and soil to air pollution that crosses national boundaries. These countries have also seen increases in their greenhouse gas (GHG) emissions. China now emits more GHGs annually than any other country, and India is fourth largest emitter worldwide.

High-growth Asian countries have gradually come to recognize that excessive use of natural resources will be followed by a depletion of those resources; this pattern is known to be a bottleneck in economic growth (OECD, 2011: 9). These countries also recognize the adverse impacts of climate change on themselves and others, and are beginning to take adaptive measures. These measures include efforts toward sustainable development; adoption of environmental laws, regulations, and administrative orders; and the establishment and development of government organizations to implement these measures.

However, many governments in Asian countries fear that focusing on only environmental protection will result in end-of-pipe solutions, which may impair economic growth and weaken their legitimacy. Governments tend to place priority on economic growth, and accordingly provide insufficient resources, authority, status, and incentives for environmental administration organizations to effectively enforce policies and measures at the street level. Sustainable development has come to be regarded as political rhetoric and a means of obtaining funding from international donors. However, the policy and institutional changes sought by international donors tend to require political, economic, and social costs that are too high for host countries to implement the changes (Mori, 2011).

Green Growth and Low-carbon Development as a Global Agenda

Against this background, a feasible and achievable paradigm (Chung, 2010: 6) was urged as a way to achieve sustainable development in Asia. In response, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) declared green growth a basic principle of its work and defined such growth as improving the ecological quality of economic growth (UNESCAP, 2008). UNESCAP defines the eco-efficiency of economic growth as maximal social benefit with minimal ecological impact, and this is regarded as a key principle of sustainability. To improve eco-efficiency, a country should adopt a long-term perspective and seek fundamental

changes in socio-economic activity and the improvement of decision-making processes that impact the use of natural resources. Several areas are of particular interest: (a) eco-tax reform; (b) sustainable infrastructure; (c) greening of business; and (d) sustainable consumption.

Discourse on green growth has spread globally since 2008, when multiple global crises occurred. The most significant of these was a global financial crisis, which was followed by global recession. As part of the recession, consumption in developed countries shrank dramatically, as did global trade. These changes increased unemployment in both developed and developing countries, widened the income gap both within and between countries, and might have worsened poverty globally. To recover from the recession, many countries increased public spending with the aim of providing economic stimulus.

In the same year, the world suffered from energy and food crises. The price of crude oil reached a peak of US\$ 145 per barrel in the middle of 2008. During the global recession, the crude oil price reached a low of US\$ 36 but had increased to US\$ 127 in 2011 as demand increased in emerging countries. Food prices also rose during this time, in part due to increasing conversion of agricultural production to energy crops.

A global environmental crisis has been recognized by researchers around the world. The Intergovernmental Panel on Climate Change has warned that the world should take actions to prevent a 2 °C rise in average global temperature by 2100 in order to avoid catastrophic damage from climate change. The Stern Review has argued that although human activities may induce major disruptions to economic and social activities on the scale of the great wars and economic depression of the first half of the 20th century, the benefits of strong earlier and effective actions to protect the environment nevertheless considerably outweigh the costs (Stern, 2007). On the same topic, Millennium Ecosystem Assessment (2005) warned of the rapid loss of global biodiversity and the degradation of ecosystem services. It is predicted that the poor would be the most strongly affected by both rising prices and global environmental crises.

The results of studies on the topic suggest that conventional economic stimulus cannot overcome all of these crises. Governments may increase consumption by enacting stimulus packages and may protect the poor from rising prices by increasing fuel subsidies, but these actions will increase energy consumption, carbon emissions, and fiscal deficits, which will intensify carbon lock-in.

The infeasibility of conventional solutions has led to the idea of a green New–Deal-style program. At the 2009 G20 Summit, the leaders stressed their commitment to “ensuring a fair and sustainable recovery for all” by making “the transition towards clean, innovative, resource efficient, low-carbon technologies and infrastructure” (Barbier, 2010: 18). The United States made a commitment to increase investment in clean energy and transmission lines. The United Kingdom, Germany, Japan, South Korea, and China followed suit, committing to either increase government

investment in green projects or provide fiscal incentives for green products and services (Table 1). At the 2010 G20 Summit, South Korea, backed by the United Kingdom and Canada, shifted the agenda from immediate and short-term measures of financial reform and stabilization to long-term policy coordination in order to implement the framework needed to ensure global prosperity. South Korea took a leading role at the summit, choosing “Green Economy” as a theme at the Rio+20 (Dodds, Laguna-Celis, and Thompson, 2014).

<Table 1 around here>

It was in this context that the concept of green growth was recognized globally. UNESCAP has initiated research and programs for the extension of green growth throughout Asia as a way to improve the ecological quality of economic growth. The Organisation for Economic Co-operation and Development (OECD), partly funded by South Korea, has published reports on strategies and progress indicators of green growth, and conducts research on green growth underway in many countries.

However, green growth is not the only discourse that emerged in this period. The United Nations Environment Programme (UNEP) has presented the concept of a *green economy* as a way to reconcile economic recovery with natural resource depletion (UNEP, 2011). The concept of low-carbon development emerged as a major challenge in both developed and developing countries as the multilateral climate negotiation became heated over setting the target for 2020. Although developed countries are reported to be responsible for 75 percent of historic GHG emissions (WRI, 2005), emissions have rapidly increased in emerging economies and they are receiving increasing criticism for their inaction on GHG emissions, based on the principle of “Common But Differentiated Responsibility.” China, India, and Brazil have recognized the benefits of low-carbon development through a clean-development mechanism (CDM), which offers them the opportunity to gain from carbon emissions reduction (CER) as well as access to the most advanced low-carbon technologies and a reduction in local environmental pollution.

Low-carbon development is defined as development based on climate-friendly low-carbon energy. Such development follows principles of sustainable development, makes a contribution toward avoiding dangerous climate change, and adopts patterns of low carbon consumption and production (Urban and Nordensvärd, 2013). Such development entails components of low-carbon *growth*, such as access to climate-friendly modern energy as an alternative to traditional fuels and fossil fuels; the promotion of low-carbon technology innovation and business models; the avoidance of carbon lock-in; and sustainable use of forest and land resources. In addition, low-carbon development addresses social justice concerns, aiming for poverty reduction and

seeking to gain the benefit of development while mitigating its harm (Urban and Nordensvärd, 2013). Thus, priority is given to emitters with development needs, and both institutional and technological approaches toward mitigation are used. In contrast to this type of approach, Mitchell and Maxwell (2010) emphasize adaptation, defining it as development that minimizes the harm caused by low emissions while working toward a more resilient future.

In response, multilateral and bilateral donors, such as the Asian Development Bank, the African Development Bank, the United Kingdom, and Germany have created programs and projects in the name of green growth/economy and low-carbon development to assist developing countries. The World Bank has created special carbon funds that invest in climate mitigation activities. In response, several developing countries have implemented green growth/economy strategies. As examples, Vietnam implemented a green growth strategy in 2012 that focuses on carbon emissions reduction and Ethiopia has implemented the Climate Resilient Green Economy Strategy to address both climate change through both adaptation and mitigation.

As a result of the global spread of the concept of green growth, green economy, and low-carbon development, the market for low-carbon environmental goods and services has grown up to reach £3.4 trillion (US\$ 5.4 trillion) in 2011/12 (Department of Business Innovation & Skills, UK, 2013).

Targets, Policies, and Measures in Northeast Asia

Northeast Asian countries have published a number of targets, policies, and measures in the name of green growth and low-carbon development (Table 2).

<Table 2 around here>

South Korea was the pioneer in establishing a framework for this. It formulated a low-carbon green growth strategy in 2008 and enacted the Framework Act on Low Carbon Green Growth in 2009 as part of the Five Year Green Growth Plan for 2009–2013. As financial support for this plan, the government agreed to spend 50 trillion won during 2009-12, 30 percent of which would be spent for rehabilitation of the four major rivers. After years of debate, the South Korean government committed to a 30 percent reduction in carbon emissions by 2020, measured against the projected emissions under a business-as-usual scenario. To work toward reduced GHG emissions, the South Korean government published the 2008 National Basic Energy Plan, which set targets for 2030 of a 46 percent reduction in energy intensity as well as the targets of having 11 percent of power generated from renewable sources and 59 percent generated by nuclear power plants. Recognizing that a feed-in-tariff (FIT) provides little or no incentive for technological development, the government replaced the FIT with a renewable portfolio standard (RPS) in 2012.

Under the RPS, the thirteen largest power producers are mandated to generate or purchase a rising share of power from renewable sources to ensure the steady growth of renewable energy. The mandated share is scheduled to rise up to 10 percent by 2022, from 2 percent in 2012. RPS is complemented by several programs and measures, such as the requirement that an increasing share of electricity be obtained from renewable sources, and the adoption of a renewable-fuel standard intended to increase the relative use of biodiesel for transportation (Duffield, 2014). In 2013, the Seoul Metropolitan government implemented a premium FIT for rooftop solar photovoltaics (PV) that exceeded the target set by the RPS. To increase grid connectivity, the government enacted a smart grid law, describing its roadmap and attracting large firms to a pilot project in Jeju Island.

In response to the 2008 global financial crisis, China implemented the world's largest fiscal stimulus. This stimulus included low-carbon components, such as the development of a high-speed train network and a subsidy for rural consumers who purchase energy-efficient electric appliances. Although China initially expressed skepticism about climate change, CDM projects have caused the government to recognize that CDMs offer an opportunity to sustain economic growth without suffering from the trilemma among increases in reliance on coal, inefficient energy use, and air pollution with which China has struggled for the past two decades (Mori and Hayashi, 2012). China enacted the Renewable Energy Law in 2006, which set an RPS for wind power. It also published the Long-term Renewable Energy Development Plan in 2007 to reframe renewable energy, which had previously been regarded as a measure for rural electrification, as a measure for industrial development. China also launched pilot low-carbon city projects with two aims: to demonstrate good practices and to include performance on carbon emissions reduction as part of the evaluation system for local leaders.

Committing to a 40–45 percent reduction in carbon intensity by 2020 in the National Appropriate Mitigation Action, China also set mandatory targets of a 16 percent reduction in energy intensity, an increase in non-fossil energy to 11.4 percent of total energy, and a 17 percent reduction in carbon intensity. These targets are part of the 12th Five Year Plan (covering 2011–2015). The Renewable Energy 12th Five Year Plan was published in 2012. This plan sets targets for the share of renewable energy at 9.5 percent for primary energy consumption and at 20 percent for electricity generation. To attain these targets, China replaced its RPS with an FIT and mandated that state transmission companies must purchase all available onshore wind power in 2010, expanding the scope to include solar power in 2012, and offshore wind power in 2014. The National Development and Reform Committee implements pilot low-carbon economic reforms in five provinces and eight cities. Accordingly, many provinces and cities are taking measures to promote a low-carbon economy; some of these locations obtain international funding, but others do not (Oberheitmann and Ruan, 2013). The committee aimed to launch a pilot emissions trading scheme in four cities

and one province by 2013¹, and the most successful one is scheduled to be applied as a nationwide scheme in 2016. Although carbon tax is under scrutiny, the government replaced the toll fee and fuel tax with a transport fuel tax in 2008, and a greening automobile purchasing tax in 2009.

Bolstered by the expansion of the Asian market and pressured by a global rise in energy prices, the Japanese government made resource productivity and recycling part of the 2008 Growth Strategy. This led to the inclusion of environmental and climate components in the fiscal stimulus as a policy response to the 2008 global financial crisis. These components provided subsidies and tax exemptions to consumers who purchased certified energy-efficient electric appliances or certified low-emissions/high-fuel-efficiency automobiles. Japan instituted a fixed FIT for solar power, although this was limited to surplus power and power generated by rooftop PV. In addition, green innovation was promoted as a key strategy, inspiring the Future City Initiative. This initiative aimed to develop a package of infrastructure for mass production and use of renewable energy in the designated cities and towns as part of the 2010 National Growth Strategy. It was not until the Fukushima nuclear disaster, however, that the Japanese government decided to implement a fixed FIT mandating that incumbent electric power companies must purchase *all* renewable energy, and a carbon tax added as a surcharge to the current Coal and Oil Tax. However, the government abandoned its mid-term GHG emissions reduction target in 2013, and has hesitated to set targets for renewable energy and nationwide energy efficiency, let alone a new GHG emissions reduction target. This is a direct consequence of the shutdown of nuclear power plants after the Fukushima nuclear disaster.

Taiwan has not officially submitted a Nationally Appropriate Mitigation Action plan to the United Nations Framework Convention on Climate Change, but it has set the amount of year-2000 level of GHG emissions as the target for 2025. To attain this target, it enacted the Renewable Energy Development Law in 2009, which implemented a fixed FIT and set targets for the share of renewable energy and energy intensity.

Features

The targets, plans, and policies described above demonstrate the features characteristic of green growth, low-carbon development in Northeast Asia. These features are as follows. First, although green growth and green economies, in particular, are intended to address a wider range of global environmental challenges, Northeast Asian countries have paid most of their attention to renewable energy development and, to a lesser extent, nuclear power. UNEP (2011) and Barbier (2010) identify reducing coal dependence, protecting biodiversity, and conservation of water as key areas

¹ Guanzhou city and Hubei province were scheduled to implement this by 2013 but did not do so.

for a green economy. UNESCAP (2008) defines green growth as eco-efficient economic growth and include broad ecological challenges. In practice, however, countries in Northeast Asia have paid the most attention to renewable energy.

This focus is related to the second feature: climate management is being reframed from least-cost climate mitigation and adaptation to a means of economic opportunity (Zadek, 2013: 199). Environment and the associated climate challenges have been made the primary target for investment and growth, which has encouraged the development of domestic low-carbon industries as a means to enhance national innovation capacity; such innovation will not only use imported low-carbon technologies for and in production but also develop the knowledge and expertise to create such technologies (Bell, 2012). Capturing a share of the global market in low-carbon goods and services will be sought through export. This is in line with the existing export-oriented industrialization strategy in East Asia, which aims to increase the export share in gross domestic product and to shift production upstream in the supply chain. This shift occurs through diversifying products and services, which also enhances resilience to external shocks such as the 1997 Asian economic crisis.

Third, the governments of countries in Northeast Asia have centralized their administrative structure so that the president and/or prime minister can directly command and control the related issues. In the past, the authority and responsibility for climate issues was split among a variety of ministries, which deterred coordination among ministries, integration among related policies, and implementation of integrative policies. Toward that end, South Korea established the Presidential Committee on Green Growth as the headquarters for green growth, and appointed ministers and industrial associations as members. China appointed the task to the National Development and Reform Commission, the most powerful commission in the government, to integrate climate concerns into energy policy. In Japan, the Prime Minister's Office took over the headquarters function to advance GHG emissions reduction through management by objective and results.

Evaluation Criteria

How do we evaluate green growth, low-carbon development in Northeast Asia?

The first group of criteria is development and job creation in the green sector. Green growth, green economy, and low-carbon development have been initiated as part of fiscal stimulus packages to overcome the global financial crisis, but with a greener approach. In addition, Northeast Asian countries are framing the issues as an economic opportunity, and so green industrial policies receive especial focus, particularly in renewable-energy industries. Governmental policies have induced domestic companies to make investments in a few specific sectors as a way of localizing production and increasing exports. In the process, participating companies can acquire the

production capacity to adapt to customers' needs and can take advantage of economies of scale to compete in the global market.

The second group of criteria includes changes in socio-economic activity and improvements to the decision-making processes that affect the use of natural resources. Green industries may remain niche industries and become ultimately unprofitable unless they are associated with changes in the socio-technical regime. The growth of renewable energy will be limited because economic, political, social, environmental, technical, and geographic barriers impede the transformation of energy systems (Urban, 2013: 13-14). Transformation of energy systems has three possible transitional pathways: the "transitional pathway," which is characterized by further hybridization of the current infrastructure; the "reconfiguration pathway," which features internationalization and a scale increase of renewable generation leading to the emergence of a super grid; and the "de-alignment and re-alignment pathway," which is dominated by decentralized distribution of electricity with local or regional generation and balancing (Verbong and Geels, 2010). The transformation may go hand in hand with the removal of fossil fuel subsidies and carbon-energy taxation. However, there is a risk that the transformation might be implemented at the expense of the poorest people in societies, especially in places where the government does not always spend its budget for public goods and services that benefit the poor. Higher upfront capital requirements will deter companies and households from installing energy management systems, despite a substantial net benefit in the long term. Top-down technological approaches will face political, economic, social, and technological barriers. Full inclusion of the views of the end users will be important in any scale-up of renewable energy. This makes it imperative to change the decision-making process in such a way that it integrates bottom-up policies as part of governance.

The third group of criteria is environmental side effects. Although green growth and low-carbon development are intended to enhance resource productivity, they may cause cross-media transfer of the problems or displace problems to other countries, as typically seen in exploitation of natural resources and recycling in foreign countries. This will increase the global environmental load unless importing countries properly manage the effects. Ongoing liberalization of international trade and foreign direct investment can accelerate this geographical transfer, resulting in the concentration of dirty activities to certain areas, which will become severely polluted. Although multilateral agreements, such as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal may prevent exports of listed hazardous wastes, they do not prevent the export of re-usable and/or recyclable goods that are likely to be improperly managed at the destination, which will result in pollution.

In addition, green/low carbon consumption in one country may not be always adopted in other countries. Codes and standards ensure certain levels of environmental performance of building and

products. Certificates help enhance the credibility of products with consumers, leading consumers to make greener choices. Green purchasing and procurement help companies to enjoy economies of scale, allowing them to supply greener products at a competitive price. All of these things encourage companies to implement green supply chain management globally so as to minimize and control pollutants in the lifecycle of products. In the process, companies select suppliers that can comply with the required product standard and avoid those that do not. However, non-exporting companies and companies that do not transact with exporting companies may continue the production and sale of dirtier and more dangerous products in less regulated markets because these can be offered at a lower price. This may result in some places attracting companies that produce dirty and dangerous products, who are then likely to pressure governments to block enforcement of stringent product regulations. Several exporting countries may collectively establish an alternative certificate with less stringent codes and standards as a countermeasure. Such a certificate may cause a race to the bottom as it attracts an increasing number of producers.

Research Questions

This book aims to address the following three questions in relation to the discussion above.

- (a) How much have the green growth and low-carbon development strategies and policies increased production and export of green technology, goods, and services?
- (b) To what extent have the green growth and low-carbon development strategies and policies encouraged socio-technical system transformation for sustainability?
- (c) How serious have the abovementioned side effects of green growth and low-carbon development been?
- (d) What are the implications of the Northeast Asian experience of green growth and low-carbon development for developing and emerging economies outside of that region?

About the Chapters

Part I of this book focuses on the transformation of energy systems, the core aspect of green growth and low-carbon development. Northeast Asian countries have implemented renewable energy promotion policies as a way to boost renewable energy, both in industry and among energy consumers. However, the expected transition pathways, progress, and barriers vary among these nations.

In Chapter 1, Jinsoo Song describes the development of renewable energy in South Korea, showing its snail-like progress. Assuming that South Korea is going to take the “reconfiguration pathway,” he examines the idea of a super grid in Northeast Asia, coupled with massive renewable

power generation in the Gobi desert, as a tool to promote renewable energy in the region. In Chapter 2, by contrast, Fumikazu Yoshida focuses on the impact of renewable energy on local economy, with an expectation that Japan will take “de-alignment and re-alignment pathway” in increasing renewable energy. He takes renewable resource-rich Hokkaido as an example to analyze renewable energy’s potential and actual economic benefits with respect to revitalization of local economies.

In reality, Japanese government seems to take a small step toward the “transition pathway.” The Fukushima nuclear disaster opened a window for the Japanese government to change the extant policy hierarchy and decision-making process regarding energy policy. However, it hesitates to take the “de-alignment and re-alignment pathway.” Using his involvement as a government committee chair as background, Kazuhiro Ueta in Chapter 3 discusses the decision-making processes on renewable-energy development under the Cost Verification Committee and the Energy Environmental Committee and analyzes how changes in the decision-making process impacted energy and climate policy in Japan.

The Chinese government seems to be taking the “transition pathway,” because it has promoted increases in both nuclear and renewable power generation and keeps a centralized system of electricity supply intact. In the process, it changed the focus of wind-power development policy from adoption to industrial development in 2003, enhancing policies intended to foster local manufacturers while making use of foreign technology and financing at the outset. In Chapter 4, Rei Wang and Fumikazu Yoshida analyze how CDM projects pushed the development of wind power in China.

Part II extends the scope, examining the impacts of green growth and low-carbon development strategy on the pattern of international trade and evaluating the environmental and economic consequences. In addition to multilateral negotiation under the auspices of the World Trade Organization, a number of negotiations on regional trade and investment liberalization are ongoing, including those for the ASEAN Economic Integration, the Trans-Pacific Partnership, and USA–EU Free Trade Area. Countries pay little if any attention to the environmental consequences and impact on green growth and low-carbon development of such agreements during the negotiation process. As the spread of freer trade accelerates, green growth and low-carbon development strategy are likely to have a marginal impact on the industrial and trade structure so long as they cover only a limited range of industries.

In Chapter 5, Yasuhiro Ogura and Akihisa Mori quantitatively analyze the extent to which green growth strategy has changed the industrial and trade structures in South Korea, China, and Japan, with special focus on pollution-intensive and environmental industries. In Chapter 6, Lih-Chyi Wen and Chun-Hsu Lin examine the policy and state of green technology and environmental industries

in Taiwan, using a questionnaire survey to explore the challenges and barriers that Taiwanese environmental industries face. In Chapter 7, Satoshi Kojima, Pongsun Bunditsakulchai, and Mustafa Moinuddin present a global computable general equilibrium model with endogenous investment allocation across countries and regions with sector-specific capital stock to analyze the economic and carbon impacts of trade and investment liberalization in the ASEAN Plus Six (ASEAN nations, plus Japan, South Korea, China, Australia, New Zealand, and India) under several scenarios. This analysis discusses the implications of reconciling trade and investment liberalization with low-carbon development.

Chapters 8 and 9 focus on the side effects of the green growth and low-carbon development strategy. In Chapter 8, Soyoung Kim and Akihisa Mori examine South Korea's export of used electric appliances and analyze the incidence of costs and benefits to various stakeholders, such as producers, recyclers, and the government of South Korea, as well as Vietnam, an importing country, under the extended producer's responsibility program. In Chapter 9, Etsuyo Michida examines product-related environmental regulations to quantitatively demonstrate how these stringent environmental regulations in developed countries affect trade and industrial structures in developing countries through the transnational supply chain. She uses data on the EU RoHS and REACH frameworks to analyze trade and environmental impacts on Malaysia and Vietnam.

Part III explores whether the green growth, low-carbon development strategy can effectively spread beyond the Northeast Asian region. In Chapter 10, Nikita Suslov examines the case of the energy-abundant emerging economy of Russia to explore why policy, institutions, and the performance of renewable energy are disappointing despite having such high potential. Chapter 11 summarizes the major findings of the chapters in terms of progress, achievements, and remaining challenges; it discusses future prospects and barriers to advancing green growth and low-carbon development toward systemic transformation and widespread adoption. The chapter also examines the inherent limitations of this strategy and shares the experiences and lessons that other countries could learn from it.

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Table 1 Green New Deal Package in Major Countries

Country	Policy summary	Amount of planned investment	Expected new green jobs
United States	Investment on clean energy and transmission lines	US\$ 150 billion for a decade	5,000,000 for two decades
United Kingdom	Prime minister announced the transition to low carbon society in 2008. Investment more than GBP 100 billion on ocean wind power by 2020.	GBP 50 billion for coming three years	16,000 by 2020
Germany	A fiscal stimulus package amounting to 100 billion euro. Renewable energy industry has a market of 240 billion euro and generates 250 thousand jobs. Provides environmental bonus and tax exemption to those who purchase new automobiles.	five billion euro	900,000 by 2020
France	A fiscal stimulus package in 2008 amounting to 26 billion euro for two years. Legislated an act that stipulates green job creation.	-	500,000
China	Published a fiscal stimulus package in 2008 to spend 4 trillion yuan by 2010. Invest 100 million yuan in 2008, of which 10% is directed to pollution control and energy saving	210 billion yuan	-
South Korea	The Framework Act on Low-Carbon Green Growth in 2009.	KWN 50 trillion during 2009-12	960000
Japan	The Green New Deal Plan and fiscal stimulus amounting to JPY 57 trillion. Plan to expand market to JPY 70-120 trillion	JPY 2.2 trillion	1,400,000
Taiwan	The Dawning Green Energy Industrial Program Economic Revitalization Policy Project to Expand Investment in Public	NTD 500 billion during 2009-12	-

Source: Ikuma and Wang (2010: 54) and Lin et al (2014).

Table 2 Plans, Strategies, Targets Policy and Measures for Green Growth and Low Carbon Development in Four Countries

	China	South Korea	Japan	Taiwan
Laws and Plans	12th five-year plan in 2011	Framework Act on Law-Carbon, Green Growth in 2009	Growth strategy in 2006, 2010	Renewable Energy Development Law in 2009
	Long-term Renewable Energy Development Plan in 2007	National Basic Energy Plan (in 2008 and 2014)	Strategic Energy Plan (in 2010 and 2014)	
	Renewable Energy Law in 2006			
Targets				
GHG emissions reduction in 2020	40-45% per unit GDP compared with 2005 level (8.5% reduction compared to BAU)	30% compared with BAU scenario (4% compared with 2005 level)	25% compared with 1990 level (suspended in 2013)	0% compared with 2000 level (in 2025)
	Renewable energy	11.4% for non-fossil fuel energy, with 35GW of solar PV capacity by 2015	11% by 2030 (in 2007) 11% by 2035 (in 2014)	6500 MW by 2030 (in 2009) 12502MW by 2030 (16.1%)
	Energy intensity reduction	16% by 2015	46% by 2030 and 11% by 2012	more than 20% by 2015 and 50% by 2025
Policies				
Renewable Energy	RPS in 2006	Fixed FIT in 2002	RPS in 2002	Fixed FIT in 2009
	FIT for wind power in 2010, solar power in 2012 and offshore wind power in 2014	RPS in 2012	Fixed FIT with mandatory purchase in 2012	

	Emissions Trading Scheme	Pilot scheme at five cities and two provinces by 2013 Nationwide scheme in 2015	Nationwide scheme in 2015	Tokyo Metropolitan area in 2010	
	Carbon-energy tax	Replacing toll fee and fuel tax with transport fuel tax in 2008		Carbon tax as a surcharge to the Coal and Oil Tax in 2012	
		Greening automobile purchasing tax in 2009			
Measures					
	Government procurement	Local content requirements in bidding wind power development projects			
	Subsidy/Subsidized loan	Fiscal stimulus to purchase energy efficient electric appliances		Subsidy and tax exemption for certified energy efficient electric appliances and low emission automobiles	
		Compensation for the loss by FIT from the Energy Development Fund in 2009			Subsidy from Renewable Energy Development Fund
		Subsidized loan from China Development Bank			

Source: author compilation.