



Green Industry
for Global Recovery
and Growth

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Round Table

REGIONAL PROGRAMME FOR ASIA AND THE PACIFIC

Is Green Industry the next
engine of growth for Asia
and the Pacific?

Background Paper



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

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I. INTRODUCTION

As economic development as a whole, and industrialization in particular, gather significant momentum in the Asia and Pacific region, impressive strides have been made to reduce poverty in the region. However, an important side effect is the unrestrained increase in the consumption of resources, which raises serious concerns about the sustainability of development patterns in the region. This increase in resource consumption has in turn led to increased generation of pollution and wastes, which has taken a heavy toll on the environment of the region and continues to have a negative effect on the quality of life of its people.

Against this backdrop of long-term concerns, the global financial and economic crises are also posing significant challenges. The current global economic crisis, thought to be the most detrimental since the Great Depression of the 1930s, has led to a significant slowdown in economic activities in the Asia and Pacific region. Trade and industrial outputs have fallen drastically, resulting in pervasive job cuts and a sharp rise in unemployment rates.

Coming at the heels of the energy and food crises, the continuing efforts of the region to lift more than 600 million of its people out of extreme poverty will surely be deterred by the economic slump. According to the Asian Development Bank (ADB), more than 60 million people in developing Asia—including 14 million in China and 24 million in India—will continue to live below US\$1.25 a day—absolute poverty line—in 2009, as a result of the economic slowdown in the region. These people could have been lifted out of poverty had economic growth continued at the pre-crisis levels. To meet the challenge of ensuring sustainable development, appropriate actions need to be taken urgently.

II. GREEN INDUSTRY: A NEW ENGINE OF GROWTH?

As a response to the global economic crisis, governments around the world have committed over US\$512 billion, in the form of economic stimulus packages, to jump-start the economy. In Asia, the largest packages were extended by China and Japan—US\$649.1 billion (or more than 15 per cent of its gross domestic product (GDP) and US\$639.9 billion, respectively. Six other developing Asian economies offered stimulus packages above 5 per cent of their GDP;

eight, between 2 per cent and 5 per cent of GDP, while in a further four countries, between 0.5 per cent and 2 per cent of their GDP.¹

An important element of these stimulus packages is that a large part will be allocated to green projects allowing the creation of new jobs in green industries and the assurance of a more efficient, low-carbon future. Green projects accounted for 81 per cent of the Republic of Korea's US\$76.1 billion economic stimulus package, and 38 per cent of China's, compared with just 12 per cent and 6 per cent of the United States and Japan, respectively.² Countries announced packages, keeping in mind their economic conditions and industrial environment. For instance, the Republic of Korea is injecting most of its money into raising energy efficiency and improving water and waste management. On the other hand, China is using such funds mainly to improve its infrastructure, such as rail and electrical grid, as shown in table 1.

As shown in table 1, green stimulus packages do not only follow the traditional approach to tackle the global financial crisis, but also focus on developing green industries and technologies. The green industry is defined by UNIDO as any industry that commits to reducing the environmental impact of its processes and products. If this is indeed the case, can green industry act as a driver of economic development in the Asia and Pacific region, and why does that driver have to be green industry and not something else? The answers to these are because the Asia and Pacific region has, to date, undergone resource-intensive economic development, significantly depleting and degrading its resources.

According to UNIDO, there are several reasons for addressing resource use at the macro and industry levels.³

- Industrial development and economic growth are closely linked to resource use and contribute to rising commodity prices.
- As a result of resource-intensive economic development, many countries have become more dependent on imports of natural resources.

¹ Asian Development Bank (ADB), "Asia's Recovery from the Global Financial Crisis-What It Takes and What Could ADB Do?" <http://www.adb.org/Documents/Speeches/2009/ms2009049.asp>

² HSBC Global Research, 25 February 2009.

³ UNIDO, Managing the transition to resource-efficient and low-carbon industries.

Table 1. The green dimension of stimulus packages in Asia and the Pacific

Country	Package	Date	Fund	Status	Period	Green fund	% Green fund	_Low carbon power		Energy efficiency (EE)				Water/Waste
								Renewable	CCS/Other	Building EE	Lo C Vech+	Rail	Grid	
			USD bn		Years	USD bn								
Australia	National building and jobs plan	03-Feb-09	26.7	Passed	2009-2012	2.5	9.3	-	-	2.48	-	-	-	-
	Budget 2009-2010	12-May-09	17.1	Pending	2009-2013	6.8	39.8	1.40	1.77	0.17	-	3.46	-	-
China	NRDC stimulus package	09-Nov-08	586.1	Passed	2009-2010	200.8	34.3	-	-	-	1.50	98.65	70.00	30.69
	Budget 2009	06-Mar-09	61.4	Passed	2009	15.6	25.4	-	-	-	-	4.95	-	10.63
Indonesia	Stimulus plan	28-Jan-09	5.9	Passed	2009	0.1	1.6	0.07	-	-	-	0.03	-	-
Japan	Package to safeguard people's daily lives	19-Dec-08	485.9	Passed	2009 onwards	12.4	2.6	-	-	12.43	-	-	-	-
	Countermeasures to economic crisis	10-Apr-09	154.0	Passed	2009 onwards	23.6	15.3	1.07	12.93	5.90	3.70	-	-	-
Rep. of Korea	Green new deal	06-Jan-09	38.1	Passed	2009-2012	30.7	80.5	1.80	-	6.19	1.80	7.01	-	13.89
Saudi Arabia	Budget 2009	23-Dec-08	126.8	Passed	2009	9.5	7.5	-	-	-	-	-	-	9.45
Sub-total Asia Pacific*			1518.9			302.0	19.9	4.3	14.7	27.2	7.0	114.1	70.0	64.7

Source: HRBC Global Research

Note: * Includes Thailand and India Stimulus.

- Increased demand for resources has also intensified global competition over limited resources and could therefore jeopardize growth and stability in the future.
- Apart from its economic impacts, resource use is also the key driver for a number of global and regional environmental problems.
- Industrial development without resource efficiency policies could result in an overuse of certain raw materials and thus create shortages, pollution and environmental degradation.
- Among many other social costs, resource-use-related environmental degradation is also exacting a heavy toll on human health and straining national health care systems.
- Forward-looking economic and environmental policies and strategies are oriented towards increased resource efficiency.

To make efficient use of resources, especially at industry level, innovation, technologies and a green mindset are necessary. In other words, green industry is the way to increase resource efficiency, providing a basis for sustainable economic development. Especially, in the Asia and Pacific region, policies to promote the green industry can be a viable strategy to solve the serious environment problems of the region and also guarantee fast and sustainable economic growth. In fact, many countries in the region are already implementing policies to promote green industry.

III. GREEN TECHNOLOGY: MARKET POTENTIAL AND PLAYERS

The global market for clean, or green, technologies has grown substantially in the past five years. This growth, driven by rising energy and water costs, was initially triggered by concerns over climate change and public demand for environmental protection. According to the United Nations Environment Programme (UNEP), the world market for environmental goods and services stands at US\$1.3 trillion, and if present trends continue, this figure is expected to double over the next 12 years. Currently, recycling and waste management employs an estimated 10 million people in China and 500,000 in Brazil.

Growing environmental service market

The environmental service market has grown significantly, especially in the Asia and Pacific region, over the past 10 years. The 2005 OECD survey of environmental goods and services

markets, which includes six Asian countries—China, Indonesia, Republic of Korea, Pakistan, Thailand and Viet Nam—has revealed that Asian countries have changed their course of action and have adopted cleaner technologies that focus on pollution reduction at the source, instead of adhering to traditional end-of-pipe solutions. Also notable is the fact that small and medium enterprises are actively engaged in the expansion of the environmental services market.

Such recent trends in Asia have led to notable growth in water and wastewater, waste management, generation technologies, air pollution control and environmental consultancy. Moreover, there has been rapid growth in renewable energy and low carbon technologies, often exceeding 10 per cent per year.

The environmental services market in Asia is expected to expand further. There are considerable opportunities for Asia in this sector, considering the urgent need for clean air and water, but at the same greater mitigation action is necessary. India and China are predicted to have the fastest growing economic goods and services markets, which is understandable considering the size of the countries and the scale of the challenge. The 1999 European Union study projected that growth in the environmental goods and services market to 2010 will be highest in Southeast Asia and China—14 per cent and 12 per cent annually, respectively.

Growing investment in green technology

In tandem with increased demand, global investment in clean technologies is also rapidly increasing, and is the fastest growing area of venture capital investment. In 2008, global venture capital investment in clean technology companies was approximately US\$8.4 billion globally, up 38 per cent from US\$6.1 billion in 2007.⁴ Investment in Asia's clean energy sector grew at a 40 per cent compounded annual growth rate between 2006 and 2008.

In the case of the ADB, clean energy has become one of ADB's highest priorities, with over one quarter, or 27 per cent (table 2), of the total approved loans in 2008 allocated to projects

⁴ Reuters, "Clean Technology Venture Investment Reaches Record &8.4 Billion in 2008 Despite Credit Crisis and Broadening Recession." <http://www.reuters.com/article/pressRelease/idUS125191+06-Jan-2009+BW20090106>

with clean energy components.⁵ Statistics show that ADB's investment in clean energy has continuously increased between 2003 and 2008, and the Bank has announced its intention to increase its investment target to US\$2 billion by 2013. To meet the energy demand, the Bank has focused its clean energy investments in both public and private sectors in various spheres: renewable energy, energy efficiency and the power sector (table 3). Its support to the power sector is extended by promoting cleaner and more efficient power plants, as well as large hydro and efficient coal power plants.

Table 2. Increase in amount of ADB's clean energy investments (Millions of dollars)

Year	Clean energy component
2003	226
2004	306
2005	757
2006	657
2007	668
2008	1,693
2013	2,000

Source: Asian Development Bank.

In 2009, ADB's total loan/investment has reached US\$1,402.3 million, and total clean energy investment, US\$868.2 million. The largest investment was made in renewable energy projects in the private and public sector, a combined total of US\$991.2 million in loan/investment, and US\$711.55 million in clean energy investment.

To meet the ever-increasing demand, both within and outside the region, Asia is rapidly becoming a major manufacturer of green products for the solar and wind energy sectors. Investment in new clean technology in Asia has therefore increased. According to the 2009 Project Report by the Energy and Resources Institute, new investment in this sector witnessed a 12 per cent increase over the previous year, amounting to US\$24.2 billion in the developing countries of the Asia and Pacific region in 2008. Again, during 2008, wind energy was the largest sector, in terms of new investment, followed by solar energy, surpassing biofuels. Total financial investment in the wind energy sector was US\$51.8 billion, down 1 per cent from 2007. Investment in the solar energy sector was US\$33.5 billion, up 49 per cent over the previous year.⁶

⁵ ADB's Clean Energy Program. <http://www.adb.org/Clean-Energy/default.asp>. Updated: 28 August 2009.

⁶ UNEP, Global Trends in Sustainable Energy Investment 2009.

Table 3. ADBs clean energy investments (Millions of dollars)

Public sector investments				
Renewable energy				
India	Uttarakhand Power Sector Investment Program-Project 3	30.6	100	30.6
China	Cecic Hike Wind Power Co. Ltd (Zhangbie Wind Power Project)	34.3	100	34.3
Viet Nam	Quality & Safety Enhancement of Agricultural Products and Biogas Development Project	95.0	20	19.1
Viet Nam	Renewable Energy Development Network Expansion and Rehabilitation for Remote Communes Sector	151.1	52	78.59
Sri Lanka	Clean Energy and Access Improvement	160.0	18	28.656
Demand-side energy efficiency				
India	Rajasthan Urban Sector Development Investment Program-Project 2	150.0	2	3.45
Philippines	Philippine Energy Efficiency	31.1	100	31.1
India	Northeastern Region Capital Cities Development Investment Program-Tranche 1	30.0	7	2.062
Supply-side energy efficiency				
India	National Power Grid Development Investment Program-Project 2	200	60	120
Public sector total		882.0		347.9
Private sector investments				
Renewable energy				
China	Sanchuan Clean Energy Development Co. Ltd. (Small Hydropower Development Project)	203.572	100	203.572
Thailand	Biomass Co. (Biomass Power Project)	76.8	100	76.75
India	Public-Private Partnership for Renewable Energy Development	40.0	100	40
China	Municipal Waste to Energy Project	200.0	100	200
Private sector total		520.3		520.3
<i>Source:</i> Asian Development Bank.				
<i>Notes:</i> *ADB Total Loan/Investment (\$ million) = 1,402.3				
*ADB Total Clean Energy Investment (\$ million) = 868.2				

There seems to be ample opportunity in Asia, as a pool for investment in environmental services and goods, as countries strive to innovate. China has become a green economic giant in Asia and is leading the region's alternative energy investment trend. It invested more than US\$15.6 billion in green energy in 2008, an increase of 18 per cent over 2007. Investments in China were highest in wind power and biofuels, making the country the world's second largest wind power market and the world's biggest photovoltaic manufacturer. Not only is China expected to further increase its wind capacity, it is also emerging as a leader in electric cars.

India is the world's largest wind energy producer. Investment in wind power is rising in Japan and Republic of Korea as well. Japan has already surpassed the United States in hybrid-car technology. The Government of the Republic of Korea is spending some US\$31 billion to fund research in 27 green technologies, including non-silicon-based solar cells, biomass fuels and carbon collection, storage and processing.

Many green technologies currently incur higher costs than the technologies they replace. Hence, only through technology learning, in the form of research, development, demonstration and deployment, will it be possible to reduce such costs and ensure that these technologies become more economical. Growing demand will also provide an economy of scale.

IV. GREEN INDUSTRIAL DEVELOPMENT IN ASIA AND THE PACIFIC: POSSIBLE POLICY OPTIONS

Green industrial development can be achieved more effectively by harnessing the potential and capacity of the entire region. It would, therefore, be useful to examine current national policies of some key countries in the region to assess the implications on future policy development.

Japan

Eco-innovation. In 2007, Japan announced its “Strategy in the 21st Century: Japan’s Strategy for a Sustainable Society” which aims to make it a leading environment-conscious nation. To achieve this goal, eco-innovation has become a key element of the Japanese strategy. Eco-innovation is defined by Japan’s Ministry of Economy, Trade and Industry (METI) as “techno-social innovations to meet the environment challenge, resource constraints and diversification of values among the people, with compatibility between economy and environment.” Therefore, eco-innovation in Japan is a new field of techno-social innovations, the scope of which can be largely categorized into three dimensions: industry, infrastructure, and consumers and personal lifestyles. To realize eco-innovation at industry level, Japan seeks to establish a sustainable manufacturing service which utilizes recycling resources and reduces usage of resources. Japan is also striving toward building and deploying a zero-emission social infrastructure, including coal-fired power generation with efficient coal/carbon capture and storage, distribution and diversification of energy sources using IT technology. Moreover, as consumers constitute a large part of society, Japan aspires to improve personal lifestyles in a more sustainable manner. Table 4 shows the scope of Japan’s green technology and industry promotion.

Target Field	Industry			
	Manufacturing service	Energy	Social infrastructure Transportation/urban	Personal lifestyle
<i>Technology</i>	<ul style="list-style-type: none"> • Sustainable manufacturing • Green ICT • Innovative R&D (energy saving, etc.) • Rare metal recycling • Innovative R&D (Building energy management system) • Energy services • Environmental Management Accounting (EMA) 		<ul style="list-style-type: none"> • Maglev • Green automobiles • Innovative R&D (intelligent transport system) 	Heat pump
<i>Business model</i>	<ul style="list-style-type: none"> • Life Cycle Assessment (LCA) • Green procurement (including B2B) • Environmental rating/green finance • Green servicing 	Green certification	Modal shift	<ul style="list-style-type: none"> • Green business • Green procurement • Green finance
<i>Societal system (Institution)</i>	<ul style="list-style-type: none"> • Environmental labeling system • Starmark • Green investment 	<ul style="list-style-type: none"> • Top runner Programme • PRS Act (Renewables portfolio standard) 	<ul style="list-style-type: none"> • Next-generation vehicle and fuel initiative (METI) • Green tax for automobiles 	<ul style="list-style-type: none"> • Telework, telecommuting • Work-life balance

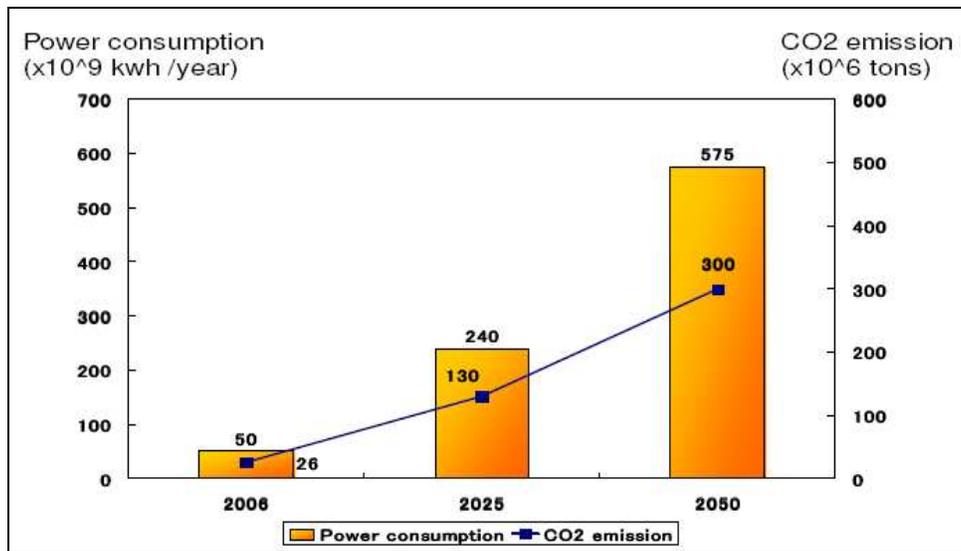
Source: METI.

Fukuda Vision and innovative technologies (IT). In 2008, Japan's ambition to become a leading environment-conscious nation was again reiterated through the "Fukuda Vision", by which Japan is to pursue a reduction of greenhouse gas emissions by some 60 to 80 per cent by 2050. In order to build a sustainable green society, the focus is once again on developing innovative technologies, with a vital role to be played by industries. METI, together with its affiliate body, New Energy Development Organization (NEDO), play a coordinating role by linking the private sector with the public sector, and promoting green research and development (R&D).

METI's Green IT Initiative. METI proposed and launched the Green IT Initiative in 2007, specifically to combat the issue of climate change. It seeks to reduce Japan's energy consumption of IT equipment and systems, and thereby reduce the resulting CO₂ emissions. As a highly advanced information society, METI has reported an increase in the estimated consumption of electricity through the use of IT equipment in 2025 for Japan, which is five times greater than that consumed in 2006 (figure 1). The level of CO₂ emissions, caused by the extensive use of IT equipment, has risen accordingly. Therefore, Japan has taken on the imperative to reduce energy consumption by developing new energy-saving green technologies. Alongside such efforts, the Government is also fostering the environmental contributions of IT to society, as a whole, and encouraging education, and training/courses in

environment and IT management.⁷

Figure 1. Forecast of national energy consumption and CO2 emissions resulting from the use of IT equipment (FY2006 – FY2050)



Source: METI, *Expectation for innovative energy-saving technologies of IT equipment*, 2007.

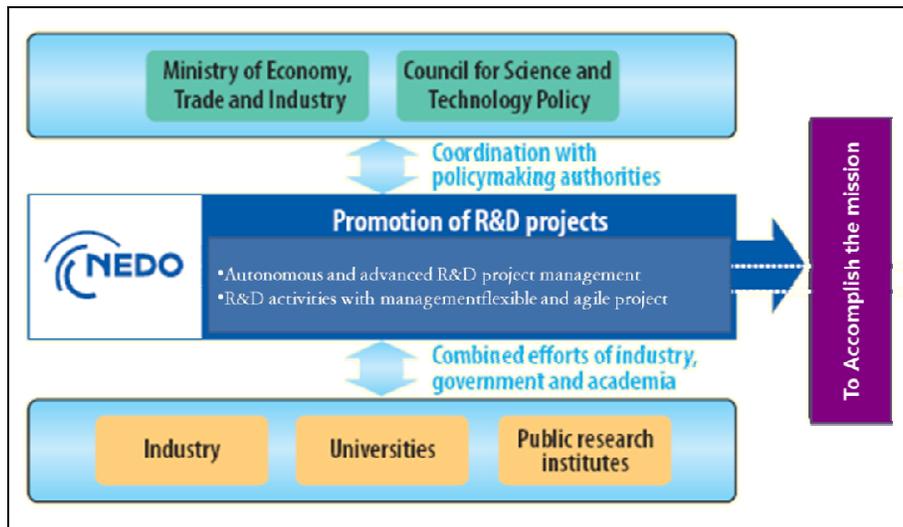
METI is currently carrying out new green IT projects, for example, nanobit technology, large OLED technology and green network system technology. The green IT initiative also includes supply chain management, which aims to improve mechanisms by creating more efficient supply chains and fostering environmentally-friendly business activities. Major Japanese ICT companies are engaged in developing green innovative technologies and reducing CO₂ emissions. For example, Hitachi is developing environmentally-friendly technologies for power reduction, and intends to reduce CO₂ emissions resulting from the manufacture of its products to 100 million tons/year, worldwide, before 2025.

NEDO and enhancement of industrial competitiveness through new green technology. NEDO, as the largest public management organization in Japan, has two missions. First, it aims to enhance Japan's industrial competitiveness and, second, to contribute to resolving the energy and global environmental problems. While promoting industrial competitiveness, NEDO also pursuing R&D in technology, which is the basis for Japan's industry. At the same time,

⁷ Mr. Hidechi Okada, Director-General, Commerce and Information Policy Bureau, METI, "Promoting Green IT Initiatives", (Presentation for Green IT Symposium held on 29 May 2009 in Tokyo).

NEDO strives to commercialize these advanced new green technologies. In this aspect, NEDO links the efforts of diverse stakeholders, for example, industry, academia, public research institutes and the public sector, to achieve the goal of raising industrial competitiveness. To address energy and global environmental problems, NEDO's activities are threefold: development of new energy and energy-conservation technologies, verification of technical results, and introduction and dissemination of new technologies. Accordingly, NEDO not only develops and introduces new green technologies, but also seeks to promote R&D and diffuse the technology for practical application. Overall, NEDO effectively interconnects the various relevant actors in society to develop new green technologies and disseminates them for practical use. Figure 2 below outlines the role and activities of NEDO.

Figure 2. Role of NEDO



Source: NEDO.

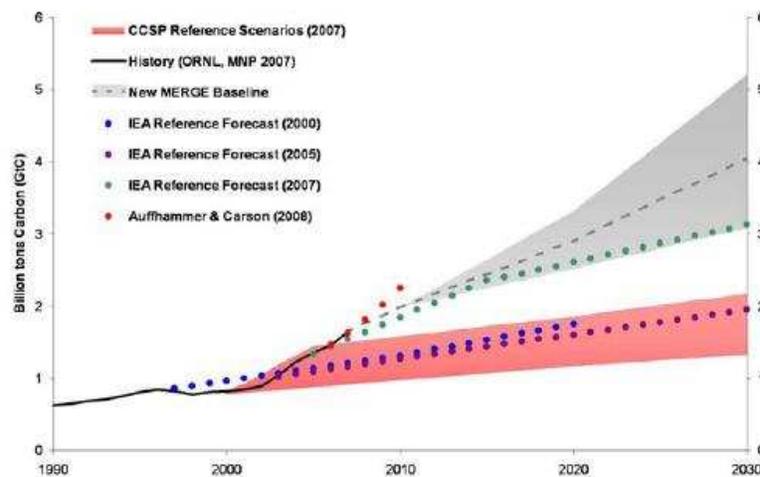
China

China is currently facing multiple challenges as it undergoes massive industrialization. China, home to one-fifth of the world's population, expects to reach a peak population by 2030.⁸ Besides, China's GDP is expected to grow in tandem with urbanization. As a result an annual GDP growth rate of between 7 and 8 per cent can be expected. This will also mean that China's demand for energy will increase and industrialization will gain greater momentum. In

⁸ The World Bank, HNPStats, Population Projection Tables by Country and Group – China.

2007, the country consumed some 2.7 billion tons of standard coal equivalent, and emitted some 7.5 gigatons (Gt) of greenhouse gases.⁹ In other words, China has already surpassed the United States emission level and its emission level is expected to increase even more. Figure 3 shows forecasts of CO₂ emissions in China by different institutions. Although projections differ by institutions, CO₂ emissions are expected to increase.

Figure.3. Energy-related CO₂ emissions in China



Source: The Harvard Project on International Climate Agreements.

In order to tackle the above challenges, China has instituted an extensive body of regulations and policies.

Circular Economy Promotion Law. China adopted the circular economy as a new paradigm for economic and industrial development—a paradigm that improves resource use efficiency and protects the environment. The Circular Economy Promotion Law came into effect on 1 January 2009. This Law is intended to promote the development of a circular economy, enhance recycling efficiency, protect and improve the environment and support sustainable development. The circular economy, as defined in the Circular Economy Law, refers to the reduction, reuse and recycling of resources during the process of production, circulation and consumption. It brings together *cleaner production* and *industrial ecology* with its application as eco-industrial development. It determines the planning rules as well as the assessment and examination system of the circular economy with the aim to conserve resources.

⁹ McKinsey, China's Green Revolution.

As regards enterprises with high energy and water consumption, the Law also calls for a stronger rational incentive mechanism to be introduced by producers in their extension and management systems. It requires:

- the Government to closely monitor energy consumption and pollution emissions of industries that use high amounts of energy and pollute heavily, including steel and non-ferrous metal production, power generation, oil refining, construction and printing;
- Government departments to promote recycling, improve standards for saving energy and reusing waste, and develop policies to divert capital to environmentally friendly industries;
- industrial enterprises to introduce water-saving technologies, strengthen management and install water-saving equipment in new buildings and projects;
- crude oil refining, power generation and steel and iron production plants to stop using oil-fired fuel generators and boilers in favour of clean energy, such as natural gas and alternative fuels;
- enterprises and Government departments to adopt renewable products, such as those related to solar and geothermal energy, in new buildings;
- enterprises to recycle and make comprehensive use of coal mine waste, coal ash, and other waste materials.

The central government will allocate funds to enterprises to encourage innovation in recycling technologies, and will also provide tax breaks to enterprises that introduce and use energy-efficient technologies and equipment.

The Circular Economy Promotion Law provides an overarching policy that could promote cleaner production and industrial ecology. To this end, China has drawn up specific regulations and policies for each industrial sector, namely, buildings and appliances, road transportation, emissions-intensive industry, power generation, agricultural and forestry and water.

Buildings and appliances sector. China, with its fast-growing population and rapid GDP growth, is experiencing a building boom. In turn, China's construction industry is booming with a predicted 20 billion square metres to be constructed by 2020—equivalent to Europe's

entire building stock.¹⁰ By 2030, the buildings and appliances sector alone is projected to emit some 3.2 Gt of CO₂. In response to this phenomenon, the Design Standard for Energy Conservation in Residential Buildings came into effect on 1 January 2006. It requires new buildings to use energy-efficient materials and insulation, and adopt energy-saving technologies for heating, air-conditioning, ventilation and lighting systems.

Road transportation. As living standards of people in China rise, the means of transportation is shifting from low-carbon vehicles, such as bicycles, to fuel-operated vehicles, such as automobiles. The ADB projects that the total number of on-road vehicles in China will more than triple by 2035 to over 400 million vehicles, including over 192 million personal passenger vehicles, approaching the size of the current United States fleet. To tackle this, China has introduced several policy measures.

China imported 47 per cent of its oil in 2006, which implies that it needs to reduce its energy dependency and secure oil to meet the future increasing demand.¹¹ It currently provides subsidies to major State-owned oil refineries in an effort to keep fuel prices from increasing further. In addition, in 2004, the Government implemented the country's first ever fuel economy standards for personal passenger vehicles. These standards have been raised every year to ensure that they compare with those of other developed countries. Further, there have been increased R&D injections into the production of hybrid cars and biofuels. Especially for biofuels, China has announced its plans to increase the production of biofuels to 6 million metric tons per year by 2010, and to 12 million metric tons by 2020.

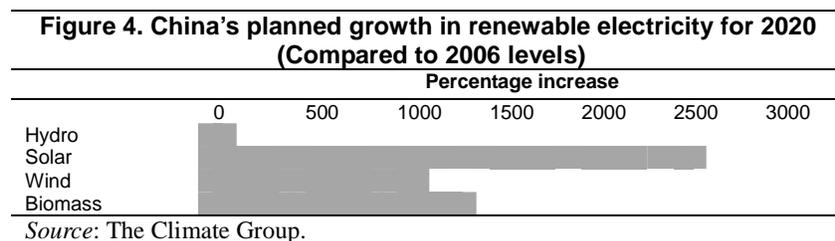
Emissions-intensive industry. In China, the emissions-intensive industries are steel-making, chemicals production, cement manufacture, coal-mining and waste management. As China expands its industrial, transportation and urban infrastructure, emissions-intensive industries will increase production to meet the demand, resulting in even more carbon emissions. The Government has, therefore, initiated several energy-efficiency efforts in the industrial sector. For example, the nationwide "Top 1,000 Enterprises Energy Saving Project," which came into effect in April 2006, aims at cutting energy consumption by setting energy efficiency targets for China's 1,000 largest energy-consuming companies. Since China's top 1,000

¹⁰ The Climate Group, China's Clean Revolution

¹¹ China Daily, http://www.chinadaily.com.cn/china/2008-04/08/content_6599920.htm

energy-consuming companies in 2005, accounted for 47 per cent of the energy used by Chinese industry and 33 per cent of the energy used by the country, this programme has become crucial for reducing carbon emissions. All companies in the programme have signed energy conservation agreements with local governments to improve operational energy efficiency by 25 per cent, on average, thus contributing to the 20 per cent national energy intensity goal. Furthermore, China's 11th Five Year Plan sets targets to eliminate inferior capacity of up to 100 million tons in steel, 250 million tons in cement, and 400 million tons in coal mines. It also mandates stricter approval procedures to ensure that new plants conform to global best practices.

Power generation. The CO₂ emissions by the power-generation sector in China amounted to 2 Gt in 2005—the largest share among the industries. China relies heavily on coal for power generation, and burning coal continues to be the single largest source of air pollutants in China. In response to this, China announced a Medium- and Long-term Development Plan for Renewable Energy in China (the Development Plan) on 31 August 2007. It set a target to increase the share of renewable energy in total energy consumption from the current 8 per cent to 15 per cent by 2020. Figure 4 shows that China will focus on four types of renewable energy: hydro, solar, wind and biomass. The Development Plan has set specific targets for 2020, such as, 30GW installed capacity for wind, 30GW for biomass, 300GW for hydroelectric and 1.8GW for solar.¹²



Furthermore, the Renewable Energy Law provides subsidies for wind and biomass power. Along with regulations and laws, China's investment in renewable energy stood at approximately US\$12 billion in 2007—almost the same level as the world leader, Germany, as a percentage of GDP.¹³ Besides, China is using power plants to produce clean coal. Since

¹² NDRC, Medium and Long-term Development Plan for Renewable Energy in China.

¹³ The Climate Group, China's Clean Revolution.

2005, the construction of large, new power plants in China has almost exclusively used efficient technology. As soon as new power plants attain the new standard levels, old, inefficient plants are shut down.

Agriculture and forestry. Agriculture and forestry together form a major part of China’s land-based carbon sink system. These sectors are critical to sustainable development. In the early 1990s, realizing the importance of sustainable development, the Government issued an Agenda for 21st Century and Forestry Action Plan. The Forests Act, as advised by Congress, together with other legislative regulations on environment, water, wildlife conservation were adopted to protect the natural resources.¹⁴ Also, the Government has standardized fertilizer dosage, taking soil characteristics and type into account, to curb the use of fertilizers, nationally.

Finance. After Germany, China is the next largest recipient of sustainable energy investment, with approximately US\$12 billion invested in 2007.¹⁵ Since the announcement of the Renewable Energy Law, China has been steadily attracting investments in varied forms (table 5). The most popular investment sources for renewable energy was asset financing, since it is less risky than other methods, such as venture capital or mergers and acquisitions.

Table 5. Breakdown of investment sources for renewable energy in China, 2006

Type	Percentage
Asset financing	59
Venture capital/Private Equity	17
Mergers and acquisitions	12
Public markets	12
Total	100

Source: The Climate Group.

China is not only attracting massive foreign, but also domestic, investments in its renewable energy sector. In 2007, leading Chinese banks loaned some US\$15.8 billion for industrial efficiency.¹⁶ At Government level, financial reforms are being adopted to stimulate further domestic and foreign investments.

¹⁴ Li, Xiaoping, Forestry Policy in China: the Past, Present and Future.

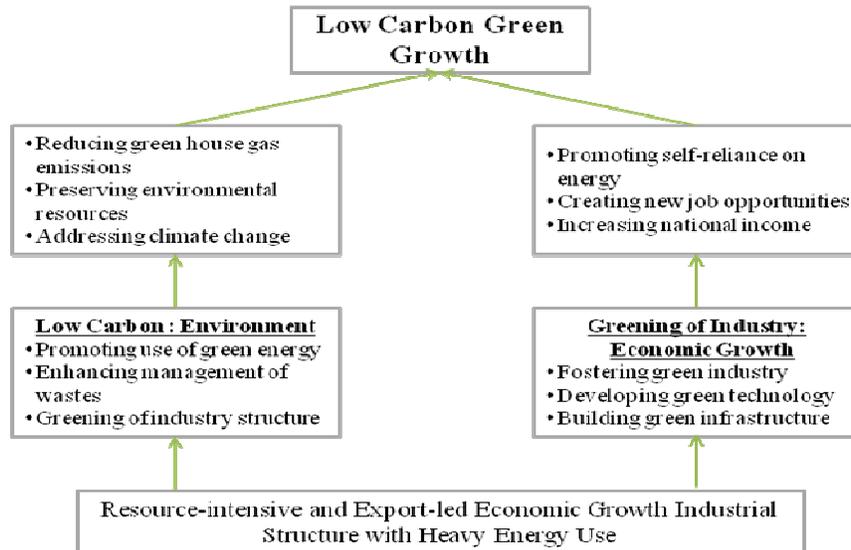
¹⁵ Renewable Energy Policy Network for the 21st Century, Renewables 2007 Global Status Report, 2008.

¹⁶ The Climate Group, China’s Clean Revolution.

The Republic of Korea

The Republic of Korea's low-carbon green growth vision and strategy. The Republic of Korea's heavy-chemical industry, witnessed rapid economic growth through export-led economic policies. The Republic of Korea is currently the world's ninth largest CO₂ emitting country, with emission levels increasing at a fast pace.¹⁷ The Republic of Korea is therefore propelling a transition to a low-carbon economy and has accordingly announced its objective for low carbon green growth. Through this concept, the Republic of Korea aspires to create a virtuous circle, which enables environment protection in conjunction with economic growth (figure 5).

Figure 5. Environment protection and virtuous circle of economic growth



Source: edited by authors

The low carbon green growth concept comprises three pillars. The first is creating a virtuous circle between environment and economy. By maximizing the synergy between environment and economy, the Republic of Korea strives to foster green technology and industry, and thus increase national income and create jobs. Furthermore, greening core industries and expanding the use of clean energy will be a course of action in response to climate change and will, at the same time, reduce greenhouse gas emissions. The second is improving the quality of life and green revolution in lifestyle. Green lifestyle can be implemented in all aspects of life, and a consumer base for green industry can be established. Cities, buildings

¹⁷ IEA, World Energy Outlook 2009.

and households can be transformed to emit low levels of carbon. Revitalizing the use of buses, subways and bicycles will be encouraged. The third is establishing an international stance that corresponds with the expectations of the international society. By actively participating in international climate change discussions, the Republic of Korea can introduce green growth as a new momentum for national advancement.

Under this paradigm, the Republic of Korea envisions becoming one of the top seven strong green countries in the world by 2020 and aspires to make it to the top five by 2050. To this end, the Republic of Korea announced three key strategies.

- Adapt to climate change and increase the energy independence level to 85 per cent by 2030.
- Promote and develop green technologies and industries as future growth engines.
- Improve the quality of life and strengthen the country’s stance as a global green leader.

In line with these three key strategies, the Republic of Korea has also announced ten policy directions (table 6).

Table 6. Republic of Korea’s Green Growth National Vision, Strategies, and Objectives

Vision	Republic of Korea: Construction of global green leader In the top seven strong green countries by 2020, and in the top five by 2050		
<i>3 Key strategies</i>	Adaptation to climate change and achievement of energy independence	Green technologies and green industries as future growth engines	Republic of Korea Global green leader
<i>Detailed objectives</i>	Energy independence level: 85 per cent by 2030	Green technology level: 100 per cent by 2030	Environmental Performance Index (EPI): 10 th by 2030
<i>10 Policy directions</i>	<ol style="list-style-type: none"> 1. Efficient greenhouse gas mitigation 2. Emphasizing low-carbon society and energy independence 3. Strengthening the capacity to climate change adaptation 	<ol style="list-style-type: none"> 4. Invest in green technology and new growth engines* 5. Foster green industrialization 6. Enhance industrial structure 7. Assist in forming basis for green growth 	<ol style="list-style-type: none"> 8. Green transformation for transport, buildings, urban and land planning 9. Green revolution in the Rep.of Korea 10. Republic of Korea to become a global green leader
<p><i>Source:</i> Presidential Committee on Green Growth.</p> <p><i>Note:</i> * The new growth engines selected for the energy and environmental section are: Clean coal energy; Marine biofuels; Photovoltaic cells; Recovery of carbon dioxide and its conversion to a resource.; Fuel cell power generation systems; and Nuclear power plants.</p>			

Green Growth 5-Year Implementation Plan. In 2009, the Government of the Republic of Korea has taken two significant steps towards becoming a green society. The Government submitted to the National Assembly the Basic Law on Green Growth in February 2009. This law will be applied and takes precedence over the Energy Basic Law, Basic Law on

Sustainable Development and other relevant laws. Therefore, the enactment or amendment of any laws will have to be in accordance with the purpose and principles of the Basic Law on Green Growth.

In July 2009, the Government also announced its Green Growth 5-Year Implementation Plans. These Plans reflect the national vision and objectives of achieving green growth and becoming a green nation and guide policy directions. Among the ten policy directions, the most notable ones relate to green technologies and green industries. The Plan focuses largely on four aspects of green technology and industries: developing green technology; greening industry; advancing the industrial structure; and establishing a green economy.

First, to develop green technology as a new engine of growth, the Government plans to increase investments in green R&D and green IT. The development of green products, such as LED, solar batteries and hybrid cars, will be encouraged so that the country's world market share of green technology products can increase to 8 per cent. Accordingly, the Government has expressed its intentions to increase R&D investment in the green sector from the approximately 15 per cent level in 2008 to 20 per cent by 2013. In addition to creating a green technology R&D base, it will build and support green technology and industry infrastructure, as well as boost international cooperation and exchange of human resources.

Second, new processes, materials and waste resources will be used in order to green key industries. Green business structure, green small and medium enterprises, and zero-emission industrial estates will be promoted. Integrated resource cyclical economic and industrial structures will be built. In particular, the greening of major industries will be pursued through the utilization of new processes, new materials and waste resources. Green management will be promoted by certifying green management, revealing best companies, and extending incentives. Through the Basic Law for Resource Circulation, a comprehensive resource circulation management mechanism will be introduced. Moreover, green clusters, based on cooperation between industry, academy and research institutions, will be established for further innovation.

Third, the enhancement of an industrial structure will be encouraged by fostering high value-added business, such as a high-technology merger industry, medical and education industries,

and transiting to a society with low energy dependency. Merger between IT, automotive and the construction sectors will be promoted. Industries focusing on environment friendly service industries, such as new composite materials, nano, biomedical, medical devices, foods, global medical service, education, solid waste management, tourism, etc., will receive Government support.

Fourth, in order to create a basis for green growth, the Plan includes the promotion of carbon emission trade in 2011 and the implementation of such trade from 2012. Furthermore, a green welfare system to support low-income families will be promoted, and an environment-friendly tax system, to meet the supply of and demand for green labour (that is, promote the labour market for green business through green certification and establishing an information system for the green labour market) will be supported.

Several sections of the Green Growth 5-Year Implementation Plans overlap with the new engines of growth that were carefully selected and announced in January 2009 as the driving forces that will lead the future of the Republic of Korea's economy over the next ten years. The designated 17 new engines of growth comprise three industrial sectors: green technology businesses (6); high-technology industrial convergence (6); and value-added services (5) (table 7).

Table 7. The 17 new engines of growth		
Green technology businesses	High-technology industrial convergence	Value-added services
1. Renewable energy	7. Merging broadcasting and telecommunication technologies	13. Global health care
2. Low-carbon energy	8. Information technology	14. Global education service
3. High-tech water treatment	9. Robotics	15. Green finance
4. Application of light-emitting diodes(LED)	10. New industrial materials and nanotechnology	16. Digital contents and software
5. Energy-efficient transport system	11. Biopharmaceuticals and medical equipment	17. Convention and tourism
6. Eco-friendly urban development	12. High value-added food products	

Source: http://www.mosf.go.kr/_policy/policy01/policy_search.jsp?hdnSubject

Overall, the Green Growth 5-Year Implementation Plans can be viewed as a step towards achieving the political aspirations of green growth.

Expected outcomes. To promote green growth, the Government has pledged to commit

approximately US\$89.8 billion¹⁸ between 2009 and 2013. This figure is some 2 per cent of the annual GDP, which is double the level recommended by the United Nations for green investment. The Government plans to reflect the relevant budget in the national financial arrangements and budget framework for the period 2009-2013.

The expected economic effects of Green Growth 5-Year Implementation Plans are relatively optimistic—results driven from the analysis of two possible scenarios. Scenario I assumes the current level of technology and industrial productivity. Scenario II postulates improved productivity emanating from green technology (green automobiles, LED, green personal computers, carbon capture and storage, fuel and solar cells, improved light-water reactors) and investment (table 8).

Table 8. Expected effects of green growth				
		Production inducement (unit: US dollars billion)	Value-added inducement (unit: US dollars billion)	Employment inducement (unit: million)
Scenario I	Total	152.8	63	118.0
	Annual average rate	36.3 (3.5 per cent of GDP)	15.0 (1.5 per cent of GDP)	23.6 (26 per cent of total unemployed)
Scenario II	Total	172.9	79.7	146.9
	Annual average rate	41.2 (4 per cent of GDP)	19.0 (1.8 per cent of GDP)	29.4 (32.4 per cent of total Unemployed)

Source: <http://www.greengrowth.go.kr/www/policy/future/future.cms>

Note: * GDP (2009) is based on a proforma GDP in 2009, and total unemployed is based on the fourth quarter of 2009.

According to the analysis, scenario I represents the lowest limit, and scenario II, the highest limit, of possible economic effects of green growth. With the promotion of the strategy, the Republic of Korea expects to induce between US\$152.8 billion and US\$172.9 billion worth of products between 2009 and 2013. This is equivalent to an annual production increase of between US\$30.4 billion and \$34.5 billion (approximately 3.5 to 4 per cent of GDP forecast for 2009). During the same period, it is expected that an additional 1.18 to 1.47 million people will be employed due to the creation of new green jobs. This translates into 236,000 to 294,000 people entering the labour force annually. It is expected that some 30 per cent of the unemployed will be provided with new green jobs in the first quarter of 2009 alone.

¹⁸ <http://ko.exchange-rates.org/converter/KRW/USD/1>

Examples of possible new jobs include greenhouse gas verification/inspection experts, carbon emission trade and consultations, related to human resources, management of green fund and screening of investment, labour devoted to green growth of small and medium industries, human resources to inspect and assess green buildings, professionals for environment-friendly low-energy architecture, green growth educator, and green volunteer groups.

Relevant ministries and local governments are designing separate roadmaps, consistent with the national strategy and the Green Growth 5-Year Implementation Plans. Once the roadmaps are accepted, new developments are to be monitored and managed by the Presidential Committee on Green Growth.

Private sector response. The chief executive officers of companies have expressed their desire to nurture green growth business as their key business.¹⁹ Among the 105 respondents (chief executive officers), 57.14 per cent (60 responses) responded that they would “ ... promote green growth business as one of their key business sectors”, while 23.81 per cent of the respondents (25 responses) answered that they would “ ... foster green growth business as their core, major business.” Those who answered that they “... understand green growth business as a subsidiary business,” or “... have no intention to increase investment” were a mere 9.53 per cent (10 responses) and 4.76 per cent (5 responses), respectively.

The sectors of major interest to companies include predominantly renewable energy and emission-reduction technology. A high interest, 35.24 per cent (37 responses), was evidenced for investment in renewable energy, while 20.95 per cent (22 responses) view emission-reduction technology as a sector with bright prospects. It was also found that companies are actually pursuing investments in green growth. with 21.90 per cent (23 responses) of the respondents who answered that they are already investing between 1 and 3 per cent of total sales in green growth business.

Major conglomerates are taking part in green growth.²⁰ Samsung Electronics is planning to

¹⁹ Mae Il Economy, “Private equity fund and Green investment by companies will continue”
<http://news.mk.co.kr/outside/view.php?year=2009&no=380036>

²⁰ Financial News, “Samsung Electronics’ green investment of 5.4 trillion won is going to reduce 50% of GHG”
http://www.fnnews.com/view?ra=Sent0601m_View&corp=fnnews&arcid=0921735051&cDateYear=2009&cDateMonth=08&cDateDay=11

invest US\$45.3 billion for green R&D and for building a green business base by 2013. Through such action, Samsung expects to reduce greenhouse gas emissions by 50 per cent at 2008 level by the same timeline. Once greenhouse gas reduction is achieved, Samsung aims to enter the carbon emission credit market. The LG Group, for its part, is preparing its entry into the carbon emission credit business at the group level. Recently, the LG Climate Change Council was launched, with the participation of six (only five listed) affiliate companies—LG International Corporation, LG Display, LG Chem, Serveone, LG CNS (spell out).

V. RECOMMENDATIONS

In order to achieve successful green growth through the promotion of green technology and green industry in the Asia and Pacific region, appropriate policy measures need to be introduced, implemented and promoted, not only at the regional, but also at the national level.

Bottom-up approach. The promotion of green technology and green industry as a way to overcome global environment problems and attain sustainable development requires both regional and national efforts. First and foremost, the identification and selection of appropriate green technology and green industry should take place at national level. Figure 6 below illustrates a good example of a bottom-up approach. It utilizes microeconomic analysis to show a clear picture of greenhouse gas abatement costs and greenhouse gas reduction effects from promoting a series of green technologies and practices. It demonstrates that many initiatives are not costly; indeed they even offer net economic benefits. It is thus a useful tool for prioritizing appropriate policy responses.

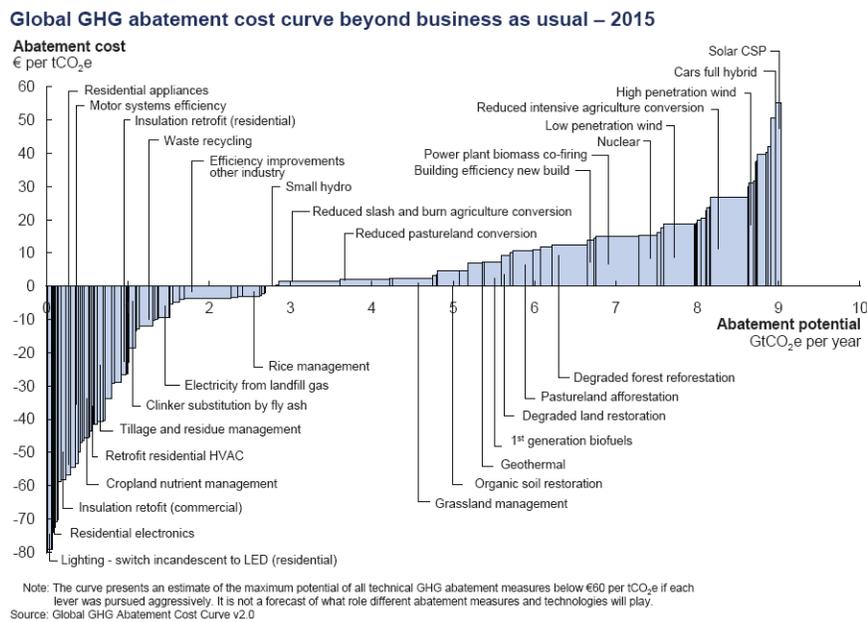
Development of a policy tool kit. For developing countries in the Asia and Pacific region to achieve sustainable industrial growth, a policy package that can support the development of an appropriate Green Industrial Development strategy at country level should be introduced. This policy package should reflect the unique characteristics of the Asia and Pacific region, and include a model that can be adjusted to reflect each country's situation.

The policy tool kit could include, but not be limited to, the following:

- Concept of the green industrial development strategy
- Methods of assessment on the status of green technology and green industry at

- country level
- Financing tools
- Development of governmental bodies to lead the development of green industrial development strategy
- Maximization of benefits from ODA
- Development of a public-private partnership
- Utilization of resources from relevant international organizations

Figure 6. Global GHG abatement cost curve



Green financing. Financing is crucial when promoting green technology and green industry in developing countries in the Asia and Pacific region. One study by a private research institute states that developing countries need between US\$100 to US\$150 billion to ensure green house gas concentrations stay below 450 parts per million.²¹ Since many major developing economies are located in the Asia and Pacific region, salient financing mechanisms should be prepared and implemented. For this, the development of policy and coordination by international financial organizations, such as the ADB and the World Bank, is necessary. Also, since sufficient financial resources cannot be secured through public financing, as

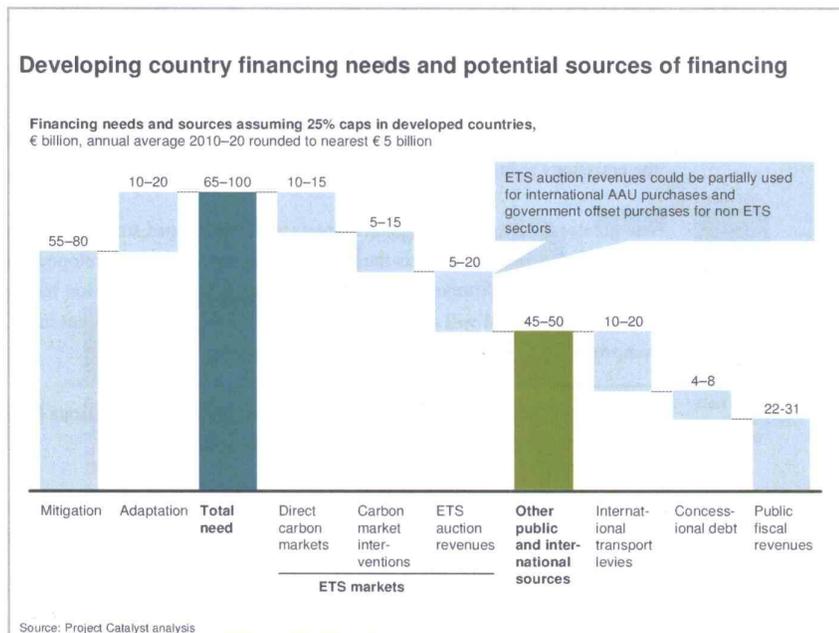
²¹ Climate Works and European Climate Foundation, Project Catalyst: Scaling up climate finance (September 2009).

demonstrated in figure 7, relevant policies would need to be developed and implemented at regional and national levels in order to encourage green financing by the private sector.

In order to maximize the effects of the green industrial development policy, the following factors also need to be considered when deploying financial resources:

- Development of green infrastructure
- Time of materialization of green industrial development plans
- Impact on the status of clean environment
- Number of jobs to be created
- Degree of mobilizing private investment through public financing

Figure 7. Developing country financing needs and potential sources of financing



Coordination of ODA. To coordinate ODA policies of developed countries in the Asia and Pacific region, synergy effects need to be drawn up, with due consideration given to the following:

- Identify areas of focus, such as clean energy technology
- Provide aid for policy development instead of facility installations
- Develop monitoring and training centres to ensure the consistent and effective implementation of ODA policies

Finally, policy guidelines for green ODA need to be developed for, and utilized by, donors and recipients alike.

Development of partnerships with the private sector. Fundamentally, green technology should be developed by the private sector and transmitted by using market instruments. Hence, building a partnership with the private sector is necessary for a green industry policy to become a feasible policy approach. One of the many ways to attain this is to launch a private-public partnership initiative on green industry in Asia and the Pacific region. This initiative could be implemented in two ways. First, pilot projects on the green technology R&D could be developed by participating public and private organizations. Second successful results from the R&D projects could be privatized through the development of relevant policy and legal measures.

Regional cooperation and the role of international organizations. Green growth and green industrial development can be more effectively achieved if the potential and capacity of the entire region could be harnessed in a coherent manner. While a regional approach is essential, international organizations have an important role to play in supporting government efforts towards the formulation, negotiation and implementation of regional strategies. In this regard, many United Nations Organizations have already launched their own green initiatives. UNIDO's Green Industry Initiative is aimed at promoting resource-efficient and low-carbon industrial development. The main objective of the Green Growth Strategy of UNESCAP is to promote sustainable green development and poverty reduction in the Asia and Pacific region. The Green Economy Initiative of UNEP and Green Jobs Initiative of ILO also have similar aims, though at the global level.

These initiatives need to be implemented in a complementary and coherent manner, and in the spirit of Delivery as One UN. In this regard, the Manila Declaration on Green Industry in Asia²² provides a useful framework for joint follow-up by the core United Nations agencies working in this area, namely, UNIDO, UNEP, UNESCAP and ILO, in consultation with their respective member States.

²² The Manila Declaration and its Framework of Action is a key output of the International Conference on Green Industry in Asia that was jointly organized by UNIDO, UNEP, UNESCAP and ILO in cooperation with the Government of the Philippines. It was endorsed by 21 participating countries on 9 September 2009.

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