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**North-East Asian Cities:  
Moving Towards Low Carbon, Green Cities**

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## ABBREVIATIONS AND ACRONYM

ACCCRN	Asian Cities Climate Change Resilience Network
BOD	Biological oxygen demand
CAIT	Climate Analysis Indicators Tool
CCI	Clinton's Climate Initiative
CCCI	Cities and Climate Change Initiative
CH <sub>4</sub>	The chemical formula for methane
CO <sub>2</sub>	Carbon dioxide
COD	Chemical oxygen demand
DMI	Direct material input
DPRK	Democratic People's Republic of Korea
EEIs	Eco-efficiency Indicators
EMC	Eco-Model City
EREC	European Renewable Energy Council
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
GCP	Global Carbon Project
GDP	Gross Domestic Product
GE	General Electric
GHG	Greenhouse gas
GEF	Global Environment Facility
ICLEI	International Council for Local Environmental Initiatives
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
ITS	Intelligent Transportation System
JICA	Japan International Cooperation Agency
JPOI	Johannesburg Plan of Implement
KW	Kilowatt
LA21	Localizing Agenda 21 Programme
MDG	Millennium Development Goal
MLTM	Ministry of Land, Transportation and Maritime Affairs
MtCO <sub>2e</sub>	Metric tonne carbon dioxide equivalent
Mtoe	Million ton of oil equivalent
NEA	North East Asia
NEASPEC	North East Asian Subregional Programme for Environmental Cooperation
NDRC	National Development and Reform Committee
NGO	Non-governmental organization
NO <sub>x</sub>	Nitrogen oxides
OECD	Organisation for Economic Cooperation and Development
RMB	Renminbi (Chinese currency)
PCBs	Polychlorinated Biphenyls
PV	Photovoltaic
POP	Persistent organic pollutant
ROK	Republic of Korea
SCP	Sustainable Cities Programme
SO <sub>2</sub>	Sulphur dioxide
SOC	Social overhead capital

SOM	Senior Official Meeting
SRO-ENEA	Subregional Office for East and North-East Asia
TOD	Transport Oriented Development
TOE	Ton of oil equivalent
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
URCM	Urban and Regional Carbon Management
USC	Ultrasupercritical
WBCSD	World Business Council for Sustainable Development
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wildlife Fund
YSCP	Yokohama Smart City Project

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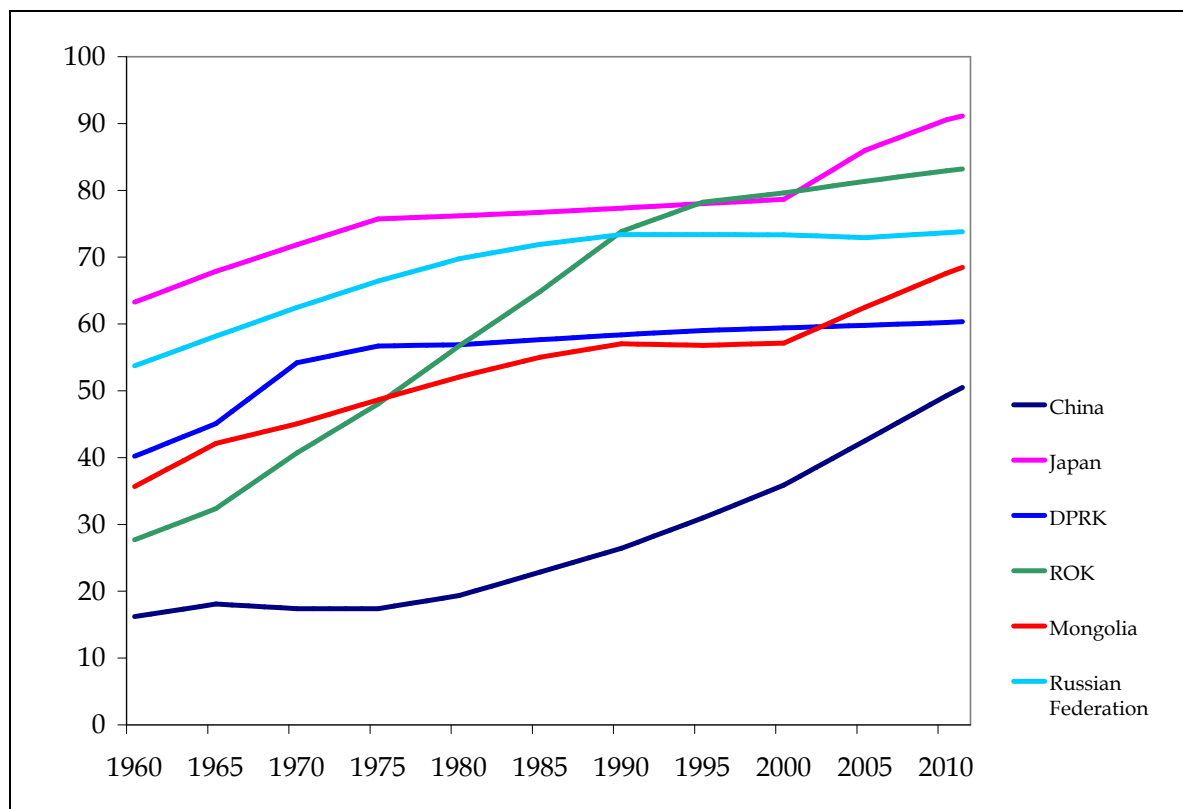
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# 1. Introduction

## 1.1 Environmental challenges and opportunities in North-East Asia

For North-East Asia (NEA), an increasing urbanization trend highlights growing economic vitality, but it also implicates environmental vulnerabilities that accompany urbanization and the life of cities. In this subregion, the urban population in 2009 was more than 830 million. Among the 30 largest urban agglomerations ranked by population size in 2010, eight cities came from this subregion<sup>1</sup>. The average share of urban population will be at 69 percent in the subregion by 2020. In particular, the urban population level in the Republic of Korea will reach 86 percent, followed by the Russian Federation (75 percent), Japan (70 percent), Mongolia (67 percent), Democratic People’s Republic of Korea (62 percent) and China (55 percent) [Figure 1].

[Figure 1] Share of urban population in North-East Asia, 1950-2050



Data retrieved from World Development Indicators (accessed 30 October 2012)

Major economies in the subregion have witnessed dramatic economic growth in the past decade. China, Republic of Korea, Russian Federation and Mongolia all achieved an average of 5 percent or above GDP growth rate between 1999 and 2010. In a 2011 report, China, Japan and the Republic of Korea, ranked the 3<sup>rd</sup>, 4<sup>th</sup> and 5<sup>th</sup> places in world oil imports<sup>2</sup>. Such economic

<sup>1</sup> World Urbanization Prospects (2011)

activity and energy consumption has contributed to the rising subregion's share of GHG emission in the world from 28 percent in 1998 to 35 percent in 2008. While relatively cheap renewable energies such as hydro, wind, and solar, as well as nuclear energy have been considered, the tragic incident in Japan in March 2011 resurrected concerns associated with the safety of nuclear energy. Such tragic events remind of the challenges for the subregion to increase the diversification of energy sources and also to increase the efficiency with which the subregion produces and consumes energy.

## **1.2 National policies for low carbon development**

In order to promote and organize the transition to low carbon growth, countries in North-East Asia have formulated various policies and developed practices related to low carbon and green cities. Japan and Republic of Korea are regarded as the leading countries in the subregion, while China has been catching up quickly. However, each country takes a different approach towards low-carbon, green city.

### **1.2.1 China**

China takes a combination of top-down and bottom-up approach. Driven by the current resources and environmental pressures, the Chinese Central Government has attached great attention to the issue of low carbon, green cities. As a top-down initiative, China's 12<sup>th</sup> Five Year Plan determined the targets and policies for the emissions reduction, by 2015: Energy intensity reduction by 16 percent and Carbon intensity reduction by 17 percent

Because of China's size, its national strategies and policies are typically interpreted and implemented at provincial and municipal levels. Key decisions regarding investment and consumption also take place at the local level. Thus, the responsibilities of achieving China's goal set by the 12<sup>th</sup> Five-Year Plan and during the Copenhagen Meeting have been allocated to provinces and cities. The construction of "low-carbon, green city" in China is on an ascent. At the national level, in practice, various programmes have been launched, including Environmental Protection Model Cities (from 1996 to 2006), National Ecological Demonstration City (from 1995 to now), Pilot City of Recycling Economy (from 2002 to 2007), Pilot City of National Eco-garden City (from 2002 to 2007), and Demonstration City for Low-Carbon Development. Across these national-level initiatives, more than 100 cities have joined to participate in the various programmes.

In particular, two bottom-up programmes, namely *the Five Low Carbon Provinces and Eight Low Carbon Cities* and *the Comprehensive Demonstration on Financial Policies of Energy-saving and Pollution Reduction*, are regarded as the most important supplementary to the 12<sup>th</sup> Five Year Plan. The former of the two was initiated by China National Development and Reform Committee (NDRC) in August 2010. It identified pilot five provinces and eight cities including the provinces of Guangdong, Shannxi, Yunnan, Hubei and Liaoning, and the cities of Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Baoding, Guiyang and Nanchang. The initiative attempts to provide practical experiences and identify appropriate strategies and tactics for localized low carbon development. The pilot areas are both geographically and economically diverse, which helps ensure that their experiences will be broadly applicable.



The latter of the two bottom-up programmes, *Comprehensive Demonstration on Financial Policies of Energy-saving and Pollution Reduction*, was launched by NDRC and Ministry of Finance in June 2011. Eight pilot cities under this programme are Beijing, Shenzhen, Chongqing, Hangzhou, Changsha, Guiyang, Jilin and Xinyu (in Jiangxi Province). This programme focuses on:

- de-carbonizing industries;
- upgrading the urban transport system to an environmentally cleaner system;
- greening buildings to promote energy-saving in building sectors;
- supporting the service industry;
- reducing main pollutants to improve urban environmental quality; and
- expanding renewable energy to optimize urban energy consumption mix.

In addition to these two programmes, many other cities have also undertaken a variety of approaches to build low carbon cities. These explorations will help to establish national guidelines for low carbon development, not only for pilot zones, but also for other cities.

### 1.2.2 Japan

In 2010, “*Bill of the Basic Act on Global Warming Countermeasures*” was approved by the Cabinet, which specified Japan's strategy to build a low-carbon society. In the Bill, Japan set its mid- and long-term targets to reduce 60-80 percent GHG emission by 2050. It was stated in the Bill that focus would be given to develop innovative technologies, popularize existing advanced technologies, and popularize renewable energy and energy conservation so that the mechanisms would come into existence to drive the whole nation toward a low-carbon society. In the same year, Japan's Ministry of Land, Infrastructure, Transport and Tourism formulated “*Low Carbon City Development Guidance*”, which is a comprehensive approach to urban development. The Guidance includes a systematic description of basic concepts and specific measures for creating a low-carbon city, and a set of simulation methods to estimate changes in carbon dioxide emissions from a city as a whole. It aims at helping municipalities take measures that enable the local authorities to identify the basic information necessary for examining measures and for promoting objective examination of comprehensive urban development, including preparation of a masterplan towards the realization of low-carbon urban structure.

Corresponding to national policies, Japan also launched two specific nation-wide programmes to implement the national policies at the city level. The first one is *Eco-model City Programme*, which has been implemented since 2008. The initiative aims to create a low-carbon society shifting from single innovations to collaborative social innovations via structural innovations in the social system. The comprehensive approach utilizes concerted low-carbon efforts by cities and communities. Another is called the “*Future City Initiative*”, which was based on *New Growth Strategy*” approved by the Japanese Cabinet in 2010. The *Future City Initiative* was issued by the Cabinet Secretariat in July 2011. It aims to create and disseminate the best practices of low carbon, green cities in Japan and abroad.

### 1.2.3 Republic of Korea

Republic of Korea's efforts include a range of policies under the framework of green growth, from a national stimulus plan to local city initiatives. In August 2008, President Lee Myung-bak proclaimed that “low-carbon green growth” would become the nation's new vision for

overcoming the challenges of climate change and a looming carbon-based energy crisis while still continuing economic growth. This policy has served as a new vision to guide the nation's long-term development. Korean version of green growth is defined as "growth achieved by saving and using energy and resources efficiently to reduce climate change and damage to the environment, securing new growth engines through research and development of green technology, creating new jobs, and achieving harmony between economy and environment."

At local level, Republic of Korea aims to transform its land structure into a low carbon, green growth-centered one by redeveloping existing cities and establishing new cities. This means the goal is to pursue a low-carbon and disaster-free land structure. Within this context, the government launched *EcoRich City* for supporting green growth of cities. According to Korean National Commission on Sustainable Development, seven cities have been identified as EcoRich City where government agencies' green ocean policies are combined to promote green growth. Then, the designation will be expanded to other cities in a gradual manner beginning in 2013. The EcoRich Cities focus on the improvement of the city environment as well as on creating new jobs in energy, commuting, recycling, etc. EcoRich City concept combines separate policies of each ministry to provide a comprehensive approach for cities to achieve green growth.

In 2009, the Ministry of Land, Transportation and Maritime Affairs (MLTM) announced "Urban Planning Guidelines for Low-Carbon Green Growth", which deals with standards, evaluation, and countermeasures concerning the application of low-carbon green growth concepts to urban planning factors. Furthermore, in 2010, the Low Carbon, Green Growth Basic Act was passed. It requires local governments to set the targets for energy saving and GHG emissions reduction. For example, Suwon City set its reduction target for GHG emissions of 40 percent reduction by 2030 compared to the level of 2005 under the slogan "Suwon as a Low-Carbon, Human City". Gangneung City, the first Low-Carbon Green Demonstration City designated by the Central Government, aims to reduce greenhouse gas emissions by 80 percent by 2016.

### **1.3 Existing networks and programmes**

A series of initiatives, networks and programmes for low carbon, green cities have been established and implemented in recent years. The importance to develop low carbon, green cities was also reflected in the key issues tackled during the United Nations Conference on Sustainable Development, Rio+20 in June 2012. Three of the four major issues that Rio+20 tackled related to low carbon green cities included,

- making the transition to greener economies while focusing on poverty eradication;
- making our cities more liveable and efficient; and
- broadening the use of renewable energy sources that can significantly lower carbon emissions as well as indoor and outdoor pollution, while promoting economic growth.

#### *International Council for Local Environmental Initiatives (ICLEI)*

Founded in 1990, ICLEI is an international association of local governments that have made a commitment to sustainable development. Established in 1990, the association has more than 1,200 member cities, towns, and counties across 70 countries. Currently, "building sustainable cities" is one of the key themes under ICLEI agenda, which seeks to build Sustainable Communities and Cities by enabling local governments achieve justice, security, resilience, viable economies, and healthy environments. For example, one of its initiatives is Eco-efficient

Cities, which seeks to help local governments address unhealthy environments and unsustainable production and consumption patterns. The Eco-efficient Cities initiative gives emphasis on environmental issues including air quality, energy efficiency, water resources management, waste stream management, and eco-mobility in an integrated manner.

*Global Carbon Project (GCP) Initiative on Urban and Regional Carbon Management (URCM)*

This Project was established in 2001 in recognition of the enormous scientific challenge and fundamentally critical nature of the carbon cycle for earth sustainability under the auspice of Earth System Science Partnership. The GCP launched the URCM Initiative in 2005. URCM is a scientific initiative aimed at supporting policies for urban carbon management and sustainable urban development. URCM addresses some of the most fundamental scientific issues related to carbon management. The goal of the project is to develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together.

*Asian Cities Climate Change Resilience Network (ACCCRN)*

ACCCRN is a network of ten cities across India, Indonesia, Thailand and Vietnam. It aims to enhance the resilience of ACCCRN cities against current and future climate risks. It strives to catalyze attention, funding, and action on building climate change resilience for poor and vulnerable people by creating robust models and methodologies for assessing and addressing risks through active engagement and analysis of various cities. ACCCRN is divided into four phases of development and implementation:

- Phase 1: City scoping and selection identifies city partners;
- Phase 2: City-level engagement and capacity building shares dialogues with key stakeholders about vulnerability analyses;
- Phase 3: Implementation of urban resilience strategies enacts and identifies replicable interventions in the urban climate change resilience strategies and action plans;
- Phase 4: Replication networking and shared learning within and between cities, countries and sectors, monitoring and evaluation; disseminating learning and adaptation frameworks, methods, and tools and leveraging additional funding sources for urban resilience efforts.

*C40 Cities Climate Leadership Group (C40)*

C40 is a network of large and engaged cities from around the world committed to implementing meaningful and sustainable climate-related actions locally that will help address climate change globally. A total of 58 global cities are members of C40. The C40 was created in 2005 by former Mayor of London Ken Livingstone, and forged a partnership in 2006 with the Cities Programme of President Clinton's Climate Initiative to reduce carbon emissions and increase energy efficiency in large cities across the world.

*Eco2 City Programme*

Launched by the World Bank, Eco2 Cities are cities that create economic opportunities for their citizens in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and global public goods. This programme aims to help cities in developing countries achieve greater ecological and economic sustainability. The programme will provide practical and scalable, analytical and operational support to cities. This programme consists of four key principles, including a city based approach, an expanded platform for collaborative design and decision making, a one-system approach and an investment framework that values sustainability and resilience.

### *UN-HABITAT*

UN-Habitat is the United Nations agency for human settlements. It is mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all. UN-HABITAT's strategic vision is anchored in a four-pillar strategy aimed at attaining the goal of “Cities without Slums”. Currently, UN-HABITAT has three major programmes related to low-carbon, green cities, including:

- The Sustainable Cities Programme is a joint UN-HABITAT/UNEP facility established in the early 1990s to build capacities in urban environmental planning and management. The programme targets urban local authorities and their partners. It is founded on broad-based stakeholder participatory approaches.
- The Localizing Agenda 21 Programme aims to help local authorities in secondary towns to achieve more sustainable development by implementing an environmental planning and management process to identify and address priority issues.
- UN-Habitat's Cities and Climate Change Initiative seeks to enhance the preparedness and mitigation activities of cities in developing and least developed countries. It emphasizes good governance, responsibility, leadership and practical initiatives for local governments, communities and citizens. Building on UN-HABITAT's long experience in sustainable urban development, the Cities and Climate Change Initiative helps counterparts to develop and implement pro-poor and innovative climate change policies and strategies.

## **2. Low Carbon, Green Cities in North-East Asia: An Overview**

The concept of Low Carbon, Green City centers on two keywords, namely “low-carbon” and “green”. With the more recent concern over climate change, cities taking forefront position in climate change agendas, and with efforts to develop, manage and renew cities to be more sustainable - more cities have taken holistic and comprehensive approaches to achieve the target of being low-carbon and green. A low-carbon city strives to reduce drastically the anthropogenic emissions of Carbon dioxide (CO<sub>2</sub>) and other GHGs in order to mitigate the threats of climate change. Parallel to the evolution of the concept of “low-carbon” cities, the concept of green city brings together the notions of urbanism and nature, which provides us with an opportunity to create cities that are healthy, civilizing and enriching.

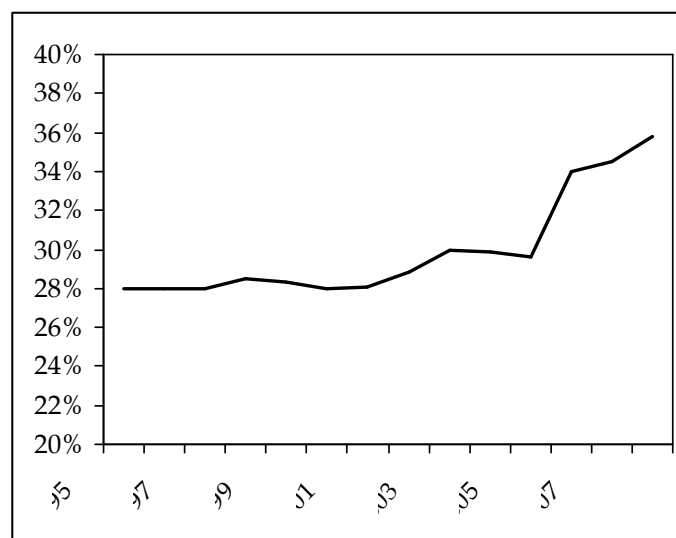
A low carbon green city is an idea that has recently appeared as a way to fight climate change. The low carbon, green city intends to systematically incorporate mitigation and adaptation measures to enable the city to respond to climate change through a well-planned and designed urban environment. Through such a plan, the low carbon, green city can improve the energy efficiency and water use within a city, and promote the development of green fields and wind power, all of which are part of the climate agenda. Each country justifies the concept of low-carbon and low-carbon city in their own way. Recently, China launched a large-scale campaign of building low-carbon cities, in which low-carbon city refers to a city which can keep low-carbon manufacturing and consumption, construct a resource-saving and environment-friendly society, and achieve a well sustainable energy ecological system. Japan has actively promoted low-carbon city's construction in the process of building a low-carbon society. For Republic of

Korea, low-carbon city interprets to “carbon neutral city, which pursues sustainable future growth in environmental values.”

## 2.1 Imperatives for low carbon, green cities in North-East Asia

In North-East Asia, the subregion has witnessed tremendous economic growth in recent decades but at environmental cost. **Error! Reference source not found.**] shows the sum of CO<sub>2</sub> emissions of all six North-East Asia countries between 1995 and 2008. The fraction of North-East Asia in global CO<sub>2</sub> emissions is projected to increase from 20 percent in 1990 to 35 percent in 2030.

[Figure 2] Share of CO<sub>2</sub> emissions of NEA countries in the world 1995-2008



Source: The Climate Analysis Indicators Tool (CAIT),2012, <http://cait.wri.org/>

Within the total Asia-Pacific, the subregion accounts for almost 60 percent of total GHG emissions. China as the global top emitter of GHG accounts for more than 65 percent of CO<sub>2</sub> emissions in North-East Asia and about 20 percent of global emissions. This represents a tremendous challenge, for cities across the region, in delivering cost-effective and affordable services to a growing urban population.

[Figure 3] Change in CO<sub>2</sub> emissions between 1998 and 2008

	[kt]	1998	2008	Percent Change
<b>China</b>		3324344.52	7031916.21	112%
<b>Japan</b>		1159186.37	1208162.82	4%
<b>DPRK</b>		64927.90	78371.12	21%
<b>ROK</b>		363839.74	509170.28	40%
<b>Mongolia</b>		7708.03	10894.66	41%
<b>Russian Federation</b>		1511269.71	1708653.32	13%

Source: World Development Indicator

The scenario for North-East Asian countries is unmistakable: unless economic growth is decoupled from environmental resource use, their ecological footprint will continue to increase while their carrying capacity steadily decreases. Choices made in urban development will have a major influence on the competitiveness, quality of life and sustainability of cities. A justifiable alternative for averting this unsustainable pattern of growth is for North-East Asian economies to improve their ecological efficiency (or eco-efficiency).

## 2.2 Eco-efficiency as a tool for developing low carbon, green cities

United Nations ESCAP's 2008 *Project concept note for test application of eco-efficiency indicators* defines "eco-efficiency" as the efficiency with which resources are used for consumption and production activities as well as the extent of environmental damage resulting from wasteful consumption and production activities. To better explain the linkage between economic activity, resource usage and environmental impact, UNESCAP undertook a project entitled "*Pursuing Green Growth by improving eco-efficiency of economic growth in Asia and the Pacific*", in which a Framework for Eco-efficiency Indicators (EEIs) was developed. The following framework for EEI and the selected indicators shown in [Table 1] reflect the discussions at the EEI Second Expert Group Meeting held in April 2008, which was organized under the Project of "*Pursuing Green Growth by improving eco-efficiency of economic growth in Asia and the Pacific*". In this regard, the eco-efficiency approach was introduced as a concrete tool for cities to shift from brown pattern of economic and social activities to a greener pattern.

[Table 1] Framework of & set of EEI using monetary output as numerator

	Resource use intensity	Environmental impact intensity
<b>ECONOMY-WIDE INDICATORS</b>		
	<ul style="list-style-type: none"> <li>• Water intensity [m<sup>3</sup>/GDP]</li> <li>• Energy intensity [J/GDP]</li> <li>• Land use intensity [km<sup>2</sup>/GDP]</li> <li>• Material intensity [DMI/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• Emission to water intensities [t/GDP]</li> <li>• Emission to air intensities [t/GDP]</li> <li>• GHG emissions intensities [t/GDP]</li> </ul>
<b>SECTORAL INDICATORS</b>		
<b>Agriculture</b>	<ul style="list-style-type: none"> <li>• Water intensity [m<sup>3</sup>/GDP]</li> <li>• Energy intensity [J/GDP]</li> <li>• Land use intensity [km<sup>2</sup>/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> intensity [t/GDP]</li> <li>• CH<sub>4</sub> intensity [t/GDP]</li> </ul>
<b>Industry</b>	<ul style="list-style-type: none"> <li>• Energy intensity [J/GDP]</li> <li>• Water intensity [m<sup>3</sup>/GDP]</li> <li>• Material intensity [DMI/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> intensity [t/GDP]</li> <li>• Solid waste intensity [t/GDP]</li> </ul>
<b>Manufacturing</b>	<ul style="list-style-type: none"> <li>• Energy intensity [J/GDP]</li> <li>• Water intensity [m<sup>3</sup>/GDP]</li> <li>• Material intensity [DMI/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> intensity [t/GDP]</li> <li>• BOD intensity [t/GDP]</li> <li>• Solid waste intensity [t/GDP]</li> </ul>
<b>Public Services</b>	<ul style="list-style-type: none"> <li>• Energy intensity [J/GDP]</li> <li>• Water intensity [m<sup>3</sup>/GDP]</li> <li>• Land use intensity [km<sup>2</sup>/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> intensity [t/GDP]</li> <li>• Wastewater intensity [m<sup>3</sup>/GDP]</li> <li>• MSW intensity [t/GDP]</li> </ul>
<b>Transport</b>	<ul style="list-style-type: none"> <li>• Fuel intensity [J/GDP]</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> intensity [t/GDP]</li> </ul>

Source: United Nations ESCAP, 2008

### 3. Plans for Low carbon, Green City Development in North-East Asia

This chapter provides a sectoral analysis of existing city plans related to the development of low carbon and green city in North-East Asia. The advantage of sectoral approaches is that targeting key sectors can enable city authorities to focus efforts on sectors where action is the greatest priority. Sectoral approaches can also give governments the possibility to choose sector-differentiated commitments, for example efficiency standards for one sector, emission reductions for another, etc.

#### 3.1 Energy

In the past three decades, the North East Asia subregion has experienced the fastest economic growth in the world, accompanied by rapid urbanization. World Banks study *East Asia's Sustainable Energy Future* finds that energy consumption has more than tripled and is expected to further double over the next two decades. As Table 3.3 indicates, total energy consumption in the subregion in terms of thousand tones oil equivalent accounted 30 per cent of the world total in 2008, with its member countries such as China, Russian Federation and Japan ranked the 2<sup>nd</sup>, 4<sup>th</sup> and 6<sup>th</sup> place in the world. Even its per capita energy consumption, 2.8 tones oil equivalent per person, is much higher than the world average of 1.8 tones oil equivalent per person.

[Table 2] Energy consumption of North-East Asia countries in 2008

Country	Tonnes Oil Eq., Per Person	Rank in the world	Tonnes Oil Eq., Total (thousand)	Rank in the world	% of World
China	1.6	65	2,116,427	2	17.8%
Japan	3.9	28	495,838	6	4.2%
DPRK	0.8	90	20,260	59	0.2%
Mongolia	1.2	76	3,152	115	0.0%
Republic of Korea	4.7	20	226,946	11	1.9%
Russian Federation	4.8	19	686,757	4	5.8%
North-East Asia	2.8		3,549,380		29.9%
World	1.8		11,898,079		100.0%

Source: *The Climate Analysis Indicators Tool (CAIT)*, 2012, <http://cait.wri.org/>

##### China

In China, the policy on low carbon energy system is based on the following principles:

- promoting energy efficiency in industrial processes;
- introduction of energy efficiency standards for household appliances;
- making new and existing buildings more energy efficient;
- increasing the share of renewable energy generation, including decentralized power generation and building-integrated power systems (e.g. landfill gas and geothermal heating).

To reflect these principles, wind power tariffs were introduced in the country through a concession process. In 2003 the government introduced concessions to drive down costs and increase power capacity for the wind power. Due to improvements in the concession scheme

and provincial feed-in tariffs, China's wind capacity has doubled every year since 2005. As a result, in 2009 China ranked the first place in newly installed wind capacity in the world. In 2009 the government announced feed-in tariffs for wind, where the wind concession schemes provided the cost benchmarks feed-in tariffs.

China has also made impressive progress in acquiring supercritical and ultrasupercritical (USC) technology and building the local manufacturing capacity needed to produce more than 100 gigawatt per year. China then proceeded to acquire supercritical and USC technology from OECD countries. As a result, all the recently constructed power plants have been built locally at competitive prices (\$500-\$600/kW), approximately the same cost as subcritical. Today, China has the world's highest installed capacity of supercritical and ultrasupercritical plants, which are installed in 75 percent to 80 percent of new coal-fired plants.

Besides the eight pilot cities under *Comprehensive Demonstration on Financial Policies of Energy-saving*, other cities or provinces have carried out their own energy-saving projects:

- Qingdao City: Six construction projects in the port of Qingdao are currently using marine energy, which are classified as national demonstration projects, receiving RMB 47 million (US\$7 million) in financial subsidies from the central government.
- Shenyang City: Shenyang has deployed geothermal energy to heat buildings. A quarter of the total building area of the city had been installed with geothermal heating facilities by 2009. Every season, these facilities can reduce energy consumption by more than 1.5 million tons of coal equivalent.
- Hainan province: Solar-energy water heating systems have been widely used in urban and rural areas of the Province. The Provincial Government also subsidizes energy-saving light bulbs and provides financial aid in energy-saving reconstruction of road lamps and light systems of public buildings.
- Shanxi Province: Shanxi Province has implemented a de facto coal tax. It established the Coal Sustainable Development Fund in 2007 and charges all coal produced in Shanxi Province. The surcharge ranges from 5-15 RMB/ton (0.70-2.20 USD/ton) for steam coal, 10-20 RMB/ton (1.50-3.00 USD/ton) anthracitic coal, and 15-20 RMB/ton (2.20-3.00 USD/ton) for coking coal. In 2008 the total collection was RMB 14.5 billion (2 billion USD), which provided an important funding source for energy efficiency and environment protection investments.

### *Japan*

Japan's specific policies related to sustainable energy include measures in

- reducing energy load;
- improving energy efficiency;
- utilizing unused energy; and
- utilizing renewable energy.

Japan's energy scheme is greatly affected by the recent Tsunami disaster happened in March 2011. Prior to the event, stable energy was expected to be supplied by nuclear power generation in Japan. After the disaster, the potential hazards of nuclear power were reinstated, increasing the eminence of renewable energy for safe, stable and low carbon energy supply.



In order to both minimize inefficiency and to exploit all sources of energy, cities in Japan are encouraged to make a shift to a compact urban structure with low-carbon, high-efficient energy systems. In a compact urban structure, a highly dense and complex land use in integrated centers can enhance energy efficiency and introduce highly efficient and area-wide energy systems with improved energy demand densities and levels. It can introduce energy systems that utilize low-carbon energy sources by developing urban functions in close distance to untapped energy sources such as factories, waste incineration plants and sewage treatment plants.

#### *Republic of Korea*

The Five-Year Plan for Green Growth (2009-2013) gives priority to energy:

- reducing energy consumption of high-emission industries through a “negotiated agreement” with government;
- changing to a cost-based electricity pricing system;
- establishing a smart grid system by 2030;
- building 14 “Environment Energy Towns” by 2020;
- building one million energy-saving green homes by 2020 and to refurbish one million existing houses using new and renewable energy; and
- increasing share of new and renewable energy in total energy supply 3.8 percent in 2013 and 6.1 percent in 2020 and increase nuclear energy from 24 percent in 2009, to 27 percent in 2013, and to 32 percent in 2020.

The Ministry of Land, Transport and Maritime Affairs’ *Urban Planning Guidelines for Low-Carbon Green Growth* are built on the three pillars of institutionalizing regulatory foundation to address climate change influences on urban planning, reducing GHG by surveying the current emission volumes, and evaluating energy efficiency of land use plans.

#### *Russian Federation*

The priorities of the Russian Energy Strategy, which states the country will shift towards alternative energy resources mainly from 2022 to 2030, include the following goals:

- providing a complete and reliable power supply;
- keeping energy price at affordable level, while introducing energy-efficient technologies;
- decreasing the cost of energy generation and distribution by reducing consumption, increasing efficiency, and minimizing losses during extraction and transportation of fuels;
- ensuring financial stability of power sector by increasing labor efficiency and supporting the social and economic development of the country; and
- minimizing the environmental impacts from energy sector by introducing of new technologies in all stages of energy generation – from extraction to consumption.

On 23 November 2009, the government of Russian Federation promulgated *Law on Power Saving and Increase in Power Efficiency, Modification of Separate Acts of the Russian Federation*. The Law introduces energy efficiency standards for new buildings and installations. Based on this Law, a long-term project called “*Power Savings and Power Efficiency Increase for Ussuriysk City*” was developed in order to maintain rational fuel usage and to increase power efficiency of residential areas in Ussuriysk City. Between 2010 and 2014, this project is expected to increase electric energy from 97.2 percent to 98.2 percent and to increase the use of thermal energy by 64.5 percent.

## 3.2 Land Use

Sustainable land use is a fundamental requirement for sustainable development. The situation in North-East Asia in this regard may become particularly acute in the near future because of its huge, concentrated, and increasing population. Unbalanced economic development, extensive environmental degradation, and increasing burden on land and water resources place land use planning as a high priority. Moreover, factors such as expanding deserts, shrinking forests and climate change have put sustainable development of lands under great threat. Vast areas of grassland, woodland and forest in the subregion have already been lost: average annual growth rate of forests in DPRK, Mongolia and Republic of Korea were all negative from 1990 to 2010, indicating rapid loss of forests.

### *China*

Land reform has been in place in China since 1978. Since 1986, the Bureau of Land Administration has been in charge of land policy reforms with specific responsibilities including land allocation and acquisition, monitoring of land development, devising comprehensive land-use plans, and implementation of land laws. The overall objectives of land-use reforms consist of

- improving land management through land markets instead of administrative channels;
- improving land-use efficiency;
- increasing government revenues; and
- preserving farmland and controlling illegal land conversion of farmland to developed land.

A series of policies have been formulated related to land utilization in China. First, *Land Administration Law* passed in 1986 had legalized private organizations and individuals to access the state-owned land in an attempt to develop the land market in China. Second, in order to provide concrete legal guidance, the State Council announced "*Provisional Regulation on the Granting and Transferring of the Land Rights over State-Owned Land in Cities and Towns*" in 1991. The objectives of the *Provisional Regulations* were to reform the land-use system for state-owned land in cities, to rationalize land development and land use, to enhance land management, and to promote urban construction and economic development. Third, *Land Management Law* was passed for protecting environmental and agricultural lands, promoting market development, encouraging citizen involvement in the legislative process, and coordinating the planning and development of urban land. Fourth, *Land-use Taxation* was introduced. The state passed the *Provisional Act of Land-Use Taxation on State Owned Urban Land*, which was to improve and rationalize urban land use, to adjust land rent differentials, to improve land-use efficiency, and to enhance land management.

### *Japan*

Japan is a world leader in promoting sustainable land use. Starting from the *1<sup>st</sup> Comprehensive National Development Plan* that was formulated in 1962, Japan's land use after the WWII had been centered around the *Comprehensive National Development Plan*, based on the *Comprehensive National Land Development Act*. With Japan's attempt to establish the national and regional planning system, the *National Land Sustainability Plan* was devised. It is a comprehensive plan to promote utilization, improvement and conservation of national land.

Today, Japanese metropolitan areas have incorporated many of the features widely promoted by the advocacy for more sustainable patterns of urban development. One feature is attaining high degree of mixed land use in urban areas. It reduces motorized-vehicle travels; and in most Japanese cities, basic services from banks, post offices, doctor and dental offices and real estate agents are within 5-10 minutes of walking distance. Another feature is to turn vacant land in the suburbs and urban fringes into farmlands, which contribute to sustainability by providing fresh vegetables and also by allowing rainfall to seep into the ground instead of discharging to sewers.

### **3.3 Building**

World Business Council for Sustainable Development in 2009 stated that buildings consumed approximately 40 percent of total energy use in the world. Although North-East Asia's emissions currently are dominated by the power and industrial sectors, over the next 20 years, the building sector is expected to grow more rapidly due to unprecedented urbanization. The reason is that with the rapid growth of urbanization, there will be more people, more households, and more offices. All these will increase service demand in indoor air conditioning of growing size home. Because a building is a complex system and the annual energy use of a building depends on many factors, including local climate, building orientation, insulation levels of the building envelope, heating, ventilation and air conditioning systems, lighting and appliance efficiency, operating schedules, and behaviors of the occupants, the cities in North-East Asia countries have adopted diversified policies to promote energy efficiency and incentives for homes and businesses to save energy according to their own local conditions.

#### *China*

In the past decade, China already underwent one of the biggest building booms in history, and the total floor space is expected to more than double from 2005 to 2030. The application of improved technology has moderated the growth of energy consumption. Energy efficient building shells, designs, and appliances have lowered energy intensity in residential and commercial buildings. China is a country catching up quickly in the area of promoting sustainable buildings. Beijing is driven by building codes that emphasize energy efficiency for new private and public buildings.

With rapid development of cities, skyscrapers spring up almost overnight in China. In order to reduce the energy consumption of skyscrapers, Guangzhou set a good example. A 71-story Pearl River Tower in Guangzhou was completed 2011, which is expected to be the largest zero-emission building in the world. Its overall environmental-friendly design is projected to make the whole structure 58 percent more efficient than a traditional skyscraper. Solar panels on the roof supply power to automated window blinds that reduce the radiative heating. Meanwhile, the skin of the building includes an air gap that traps heat, releasing it via heat exchangers. This reduces the energy consumption for air conditioning by 80 percent.

#### *Japan*

Japan and Republic of Korea, the two countries, are regarded as the pioneers in the subregion to promote sustainable buildings. Osaka and Yokohama of Japan adopted the *Comprehensive Assessment System for Building Environment Efficiency* in 2004 and 2005 respectively. The voluntary scheme provides advice on energy efficiency measures to developers, whereby "green

buildings” are certified. In Tokyo, since October 2010, *Tokyo Green Labeling System of Condominiums* requires all new residential buildings with a floor space of more than 5,000 square metres to display a record of environmental performance.

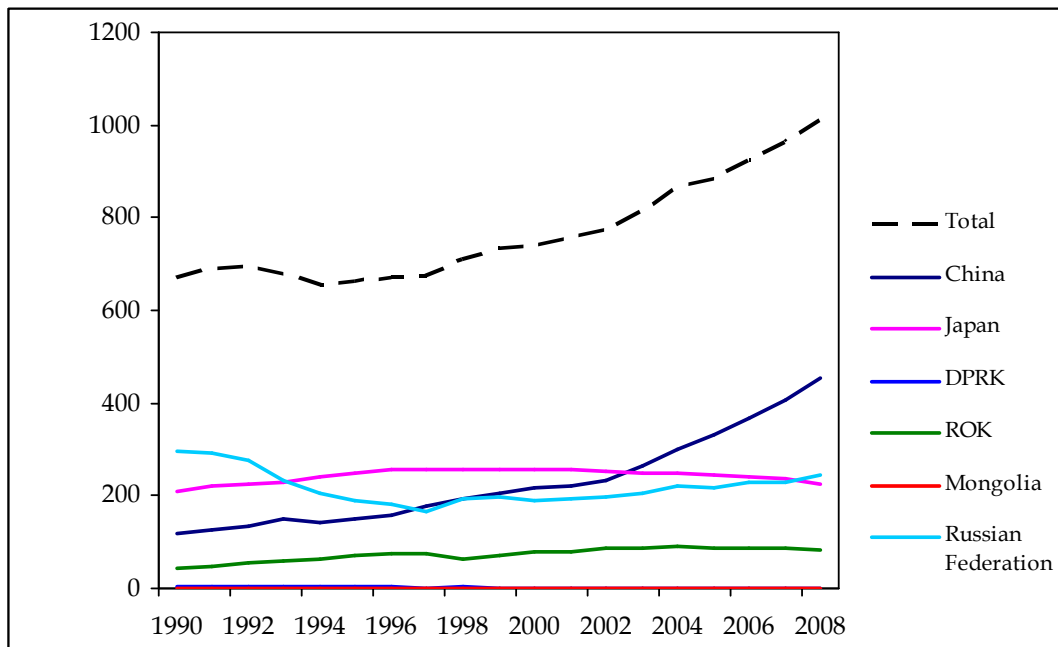
#### Republic of Korea

Seoul, the capital of Republic of Korea, implemented *Low-carbon, Green-energy Building-Design Guidelines*. The Guidelines aim to reduce buildings energy consumption by 20 percent by 2030 from 2000 levels. They include using double-glazed windows, limiting the size of balconies and replacing incandescent light bulbs with LED lights.

### 3.4 Transportation

The transport sector is a major consumer of energy resources. In 2008, the global level of energy consumption in the transportation sector amounted to 2,299 million tons of oil equivalent. Of that amount, the North-East Asia subregion was responsible for 11 percent, or 264 million tons of oil equivalent. The total amount of energy consumed by transportation sector grew by two folds from 1990 and 2008. The sector is also one of the major emitters of carbon dioxide: the North-East Asia subregion emitted 770 million tons of carbon dioxide (CO<sub>2</sub>) from its transportation sector, equivalent to 12 percent of the world’s total. This share is also on the rise as seen in [Figure 4], whereby 2008 level of CO<sub>2</sub> emissions from the transport sector was more than twice the 1990 level.

[Figure 4] CO<sub>2</sub> emission by transportation sector in North-East Asia



Source: World Development Indicators

#### China

It is further projected that both consumption of energy and emission of CO<sub>2</sub> will increase dramatically due to the fact that the total number of vehicles in China will increase

dramatically. As predicted by McKinsey Global Institute, by 2030, the number of vehicles in China will be over 330 million, ten times greater than the number in 2005.

The goal of China's transportation planning is to make low carbon transport widely available and to pursue transit-oriented development for improving access to public transportation. Under the banner of *Transit Oriented Development (TOD) Cities*, China's low carbon transport plans are focused on public transport and low carbon vehicles including bicycles and electric cars. A national demonstration project was introduced in January 2009 to deploy 1,000 new-energy and hybrid vehicles yearly for the next three years in ten cities. The aim is to let these vehicles account for 10 percent of the market in 2012. Furthermore, the planned investment in low-carbon vehicles alone is around 45 billion USD over the next five years. NDRC estimates that 3 million hybrid and 1.5 million electric vehicles will be on the road in China by 2015.

Initiated by the Chinese Ministry of Transportation in February 2011, ten cities including Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, Baoding, Wuhan and Wuxi were selected to take piloting tasks including

- establishing low carbon transport infrastructure;
- disseminating low carbon technologies and equipment;
- optimizing transport organization mode and operation approach;
- constructing smart traffic engineering;
- perfecting transport related public information service; and
- establishing and perfecting transport carbon emission management system.

In January 2008 Beijing became the first city in China to introduce the equivalent of "Euro IV" emissions regulations for passenger cars. Euro IV emissions standards are in force in Europe and set limits on various pollutants emitted by vehicles. The city has also banned trucks and buses that do not meet "Euro I" emissions standards – an earlier, less strict version of the standards – from entering the city centre between 6 am and 9 pm. The government has introduced a "cash for clunkers" programme to buy back older, dirtier cars, and gives tax rebates to consumers who buy cars with smaller, less-polluting engines. In preparation for the 2008 Olympics, the government scrapped older, more polluting buses and taxis. By 2006, more than 47,000 taxis were scrapped or replaced, out of a total fleet of 60,000; and 7,000 older buses were scrapped or replaced, out of 19,000.

### *Japan*

Japan's recent sustainable transport policies related to low carbon, green cities are reflected in the *Low Carbon City Development Guidance*, which was developed by the Ministry of Land, Infrastructure, Transportation and Tourism in 2010. The Guidance includes a systematic description of basic concepts and specific measures for creating a low-carbon city, as well as simulation methods to estimate changes in carbon dioxide emissions from a city as a whole. In transportation, the specific policies include

- shifting to a compact urban structure;
- improving road conditions;
- managing traffic;
- developing public transportation; and
- promoting the use of public transportation.

The concept of a compact urban structure is strongly encouraged, where people can live closer to their workplaces to reduce travel distances and alleviate transportation demand. Reduced travel distances, in turn, will promote a shift from passenger cars to bicycles or walking. Moreover, increasing the density of traffic demand can raise the profitability levels of public transportation, improving its service levels.

In 2009 Tokyo introduced a system of tax breaks and subsidies for electric vehicles and hybrids. Environmentally friendly cars receive 50 percent to 75 percent tax reduction depending on their vehicle model's fuel economy and exhaust emission level. Tokyo's *Ten-Year Project for a Carbon-Minus Tokyo* provides for an eco-driving campaign and a car-sharing programme, with further plans to introduce a park-and-ride system. The city has set a target to increase the average speed in the city to 25 kilometers per hour by 2016, and to increase the use of biomass fuel by metropolitan buses. Both measures will help to achieve the city's overarching plan to reduce greenhouse gas emissions related to traffic by 40 percent from 2000 levels by 2020.

The Osaka city government is in the process of installing rapid chargers for electric vehicles at ten locations in the city, including the car park of the main city office. As part of municipal policy to encourage the use of low emission vehicles, such as electric cars, natural gas-powered vehicles and hybrids, the city began introducing these vehicles for use by civil servants in April 2007.

#### *Republic of Korea*

The latest Five-Year Plan of the Republic of Korea sets regulatory standards on fuel efficiency and GHG emissions for the transport sector, requiring a redesign of cars to either drive 17 kilometers per liter or to reduce greenhouse gas emissions below 140 grams per kilometer between 2012 and 2015. New fuel efficiency and emission rules will be applied to 30 percent of automobiles sold in 2012, rising to 100 percent by 2015. In addition, it also sets measures for the development and dissemination of hybrid electric vehicles. The government will also change the existing road-based transportation system to a low carbon, green transportation system by introducing green highways, expanding bicycle paths and commercializing green cars.

## **4. Innovative Policies and Best Practices in NEA Cities**

Japan and Republic of Korea are regarded as pioneers in the subregion to promote low carbon and green cities because they started fairly earlier than the rest of the countries such as China, Mongolia and Russian Federation, who began to realize the importance of the issue in the late 1990s. This Chapter provides a number of case studies related to innovative policies and best practices on low carbon, green cities in North-East Asia. The lessons regarding technical measures, policy instruments, and application into practice could be useful for other countries and cities with similar challenges. In addition, there is also a need to take case studies of cities that show diverse characteristics and have distinct individualities that cannot be easily generalized.

## 4.1 China

China's city strategies for low-carbon and green growth pay great attention to renewable energy. The country's diversity in terms of climate, topography, resource-potential, economic-base and socio-cultural practices within the country has resulted in a variety of development patterns. Within the country, different cities have adopted different approaches towards moving to low carbon and green pathways according to their local conditions. However, related to its geographical location and size, Japan and Republic of Korea have adopted more common strategies cross the country in their approaches at the city level.

[Table 3] Low carbon development targets and actions proposed by Chinese cities

City	Low Carbon Strategy or Target	Relevant Document
<b>Baoding</b>	By 2020 reduce CO2 intensity by 35% compared to 2010; reduce CO2 per capita to less than 5.5 tons; make new energy account for 25% of industrial value.	"Opinion on Constructing Low Carbon City (draft)," 2008; "Baoding Low Carbon City Development Plan," 2008
<b>Chang-ZhuTan</b>	This city is part of a pilot "Resources Saving and Environment Friendly Comprehensive Reform Area."	Chang-Zhu-Tan City Cluster Regional Plan, 2009
<b>Chengdu</b>	By 2020, reduce CO2 intensity by 35% compared to 2010; reduce CO2 per capita to less than 5.5 tons; make new energy account for 25% of industrial value.	"Action Plan on Constructing Low Carbon City in Chengdu," 2010
<b>Chongqing</b>	By 2015, reduce energy intensity by 16% compared to 2010.	"Chongqing Low Carbon Transformation Research: Case Study in Chemical, Automobile And Energy Industries," 2010
<b>Guiyang</b>	By 2020, reduce energy intensity by 40% and carbon intensity by 45% compared to 2005.	"Guiyang Low-Carbon Development Action Plan (2010-2020)" July 2010
<b>Hangzhou</b>	By 2020, reduce carbon intensity by 50% compared to 2005 levels; increase forestry coverage above 68%.	"Implemented Opinion on the Construction of Low-Carbon City," November 2009.
<b>Jilin</b>	Emissions for Jilin City could peak in about 2020 and decline to 60% of the business-as-usual scenario by 2030. Primary energy demand not to exceed 28.18 million and 33.51 million tons of coal equivalents (tce) in 2020 and 2030, respectively.	"Low Carbon Development Roadmap for Jilin City," 2010
<b>Nanchang</b>	By 2015 reduce CO2 emissions per unit of GDP by 38% compared to 2005 levels; increase the ratio of non-fossil fuels in primary energy consumption to 7%, and increase forest coverage to 25%. By 2020, reduce CO2 emissions per unit of GDP to 45% -48% of 2005 levels; increase the share of non-fossil fuels in primary energy to 15%; increase forest coverage to 28% and the forest stock to 420 million cubic meters.	"National Low-carbon City Pilot Nanchang Implementation Plan" reported to NDRC, October 2010
<b>Shenzhen</b>	Reduce carbon intensity 32% by 2015 and 45% by 2020 compared to 2005. Make non-fossil energy account for 15% of primary energy by 2015.	"Shenzhen Low Carbon Development Medium and Long-Term Plan (draft)," April 2011

<b>Tianjin</b>	By 2015, reduce carbon intensity by 15.5% compared to 2010; reduce energy intensity by 15% compared to 2010.	"Tianjin Climate Change Program," March 2010
<b>Wuxi</b>	By 2020, reduce carbon intensity by 45%.	"Wuxi Low-Carbon City Development Strategic Planning," 2010
<b>Xiamen</b>	By 2020, reduce energy intensity by 40% compared to 2005; total carbon emission should peak by 2020.	"Xiamen Low Carbon Development Master Plan," 2010.

Source: Berkeley National Laboratory (2012) *China's Development of Low-Carbon Eco-Cities and Associated Indicator Systems*.

#### 4.1.1 Guangdong Province

Guangdong Province is located in the Southeast Coast of China. With 79 million registered permanent residents and 31 million migrants, the Province accounts for 7.1 percent of China's total population. Since 1989, Guangdong has topped the total GDP rankings among all provincial-level units in China, contributing to about one-ninth of China's total GDP. It is also listed as the 3<sup>rd</sup> highest in carbon intensity and is responsible for 8.6 percent of China's total energy consumption. Considering such conditions, NDRC designated Guangdong Province to be one of the five provinces to undertake demonstration projects in support of low carbon economy (other provinces are Liaoning, Hubei, Shaanxi and Yunnan). The Province developed Guangdong's Low Carbon Development Policy Roadmap with sector components consisting of regulatory policy, economic policy, market mechanisms and other incentives with specific quantified targets for each area. As result, in November 2010, Guangdong initiated its pilot low carbon development, with focus on the following:

- developing GHG inventory and forecasts by sectors;
- low-carbon development planning for the province;
- allocating and evaluating carbon intensity reduction target; and
- implementing carbon trade and market mechanisms.

Meanwhile, the planning methodologies for Guangdong include the following:

- sectoral-based scenario analysis;
- micro-economic analysis to quantify cost-benefit and co-benefit options;
- benchmarking with a set of targeted goals;
- technological and policy roadmap; and
- short-term and long-term action plans.

[Table 4] Guangdong's Low Carbon Development Policy Roadmap

	2010	2015	2020
<b>Regulatory policy</b>	- Phase out backward production capacity - Raise threshold for new business	- Target key energy-intensive enterprises in the 12 <sup>th</sup> Five Year Plan - Conduct carbon auditing for new buildings - Monitor provincial carbon emission	- Adopt new carbon accounting standards for listed companies - Disclose carbon emission of large-scale enterprises
<b>Economic policy</b>	- Subsidize LED equipment - Reward energy conservation	- Subsidize "10 City 10 Thousand Lamps" - Provide financing support to 10 core	- Financing through mortgaging carbon emissions allowance



		businesses for Initial Public Offering - Subsidize consumers	
<b>Market mechanisms</b>	- Participate in CDM and emissions trading - Utilize EMC services	- Create environmental and carbon taxes - Allow provincial-level voluntary emission exchange	- Link provincial carbon trade with international markets
<b>Other incentives</b>	- Create a provincial special fund for low-carbon development - Promote international low carbon technology transfer - Encourage investment in low-carbon companies through tax incentives	- Encourage more NGOs and social enterprises to register in Guangdong - Establish carbon charities - Create a low-carbon consumption trade system	

*Adopted from Liao (2011) "Development strategies of low carbon economy and urban ecology in Guangdong," presented at Suwon Conference on Low Carbon, Green Cities in North-East Asia, 17-18 October 2011, ROK.*

#### 4.1.2 Hainan Province

Hainan Province, China's only island with tropical monsoon marine climate, is located in the southernmost part of China. It is also China's largest Special Economic Zone. The Province has a land area of 33,920 km<sup>2</sup> and a population of 8.8 million. Although it is endowed with significant solar energy (47 billion KW per year), wind energy (8.2 million KW per year) and tidal energy, its geographic location forms a fragile ecosystem, making the Province vulnerable to extreme weathers.

In order to better use the natural resources while addressing environmental problems, Hainan Provincial Government adopted four practices to implement its low-carbon economy model. First, in line with the national strategy, Hainan set its goal of reducing 12 percent of energy consumption during the 11<sup>th</sup> Five Year Plan period while its GDP would grow at the rate of 10 percent. It had accomplished this target by reducing 12.1 percent between 2005 and 2010. Second, while the National Government targeted alternative energy sources to meet up to 15 percent of the new energy requirements by 2020, the percentage of renewable energy use in Hainan already occupied 30.6 percent of the total new energy consumption in 2009. Solar water heating systems have been widely used both in urban and rural areas of Hainan. The existing PV power stations generate 200 kilowatts, while 21 kilowatt projects are under construction. In addition, five wind power stations have been constructed with an installed capacity of 249.5 megawatts. Third, Hainan Government provided significant financial incentives such as subsidies for installing energy-conserving light bulbs in public buildings, energy-saving reconstruction of roads, and for upgrading sewage and waste treatment facilities. Fourth, Hainan Government abandoned energy-intensive industries and strongly promoted tourism and service industries, which led to a 20 percent increase in the added value of the service industry in 2010. In this regard, the Province also abandoned a number of energy-intense enterprises, including 400,000 ton steels plants, 138,000 kilowatt small thermal power generators, 1.76 million ton cement plants, and 21,000 ton paper manufacturing industry.

### 4.1.3 Guangzhou City

Guangzhou, as the capital of Guangdong Province, has been witnessing rapid growth in energy demand and large energy consumption. During the course of development of the city, contradiction between energy development and environmental protection has been evident. Confronted with this challenge, Guangzhou has conducted a series of studies on development of a low carbon roadmap. A scenario analysis, prepared by Mr. Ping Wang at the Energy Strategy Research Center of the Chinese Academy of Sciences, suggests that Guangzhou should take a series of actions focusing on convenient transport, green building, fuel switch, industry decarbonation and low carbon electricity, in order to decouple economic growth from environmental impacts. The specific targets under each action are the following:

#### *Convenient transportation*

- Passenger transport: reduce the share of private vehicles by 25 percent, while increasing the share of bus and train by 20 percent, and the share of bicycle and walk by 5 percent. Overall, this should lead to energy efficiency improvement by 50 percent.
- Freight transport: reduce the share of vehicles by 25 percent and 30 percent in domestic and cross border respectively, increase the share of train by 26 percent and the share of ship by 4 percent. Energy efficiency should be improved by 50 percent.

#### *Green buildings*

- Efficiency improvement: shift to equipment with high energy efficiency, such as energy-efficient appliances, office equipment, lighting, and elevators.
- Renewable energy: subsidize alternative and renewable energy sources (solar and wind energy); provide low-interest loans to buildings using renewable energy.

#### *Decarbonation of industries*

- Energy efficiency improvement: improve equipment utilization efficiency and accelerate transformation of energy management
- Industrial restructuring: eliminate backward production capacity and expand industrial scale to tertiary industry.

#### *Fuel switch*

- Traditional fuel: Promote a shift from high carbon intensity fuel to lower ones.
- New energy sources: Encourage the utilization of new and renewable energy.

#### *Low carbon electricity*

- Power generation efficiency improvement: expand power generation capacity and reduce transmission loss.
- Renewable energies: develop nuclear power plants and promote waste-to-energy schemes.

### 4.1.4 Qingdao City

Qingdao, is a coastal city located in the eastern part of China's Shandong Province. According to the Municipal Government of Qingdao, "Development of a low-carbon economy is a strategic option for Qingdao's sound and sustainable development." The Municipal Government aims to reduce carbon dioxide emissions to 1.32 tons per 10,000 yuan of GDP by 2020, a decrease of 45 percent compared to the level of 2005. In order to achieve this target, the Qingdao Government has incorporated this low-carbon economic development target into its 12<sup>th</sup> Five Year Plan (2011-2015). Qingdao has been constructing itself into a new green and low-carbon city with four systems:

#### *Energy supply system*

- Wind power: According to the characteristics of Qingdao and the environmental conditions that are rich in wind resources, the Municipal Government has introduced a series of wind power projects suitable to the local circumstances.
- Seawater energy and seawater heat exchange: Exchanging heat from the seawater by plate heat exchanger, seawater heat exchange has been gradually used in public places like restaurants in Qingdao.
- Solar energy: Qingdao strongly promotes new-type solar products, such as solar-powered air conditioning and street lights. The development of new household electric appliances also focuses on using solar energy as the power supply.

#### *Industrial development system*

- The low-carbon economy has become a consensus reflected in the R&D and production processes of Qingdao's enterprises.
- The Municipal Government encourages foreign capital flows into industries that reflect the low-carbon orientation of city development.
- Capital and loans have been provided to non-conventional energy enterprises, pollution treatment enterprises, and low-carbon service trade enterprises.

#### *Pollution treatment system*

- Enterprises with serious pollution and little improvement after rectification are being closed down.
- Rectification measures for fossil fuel enterprises are being devised.
- Elimination of "black-tailed vehicles" are underway.

#### *Environment protection and low-carbon awareness system*

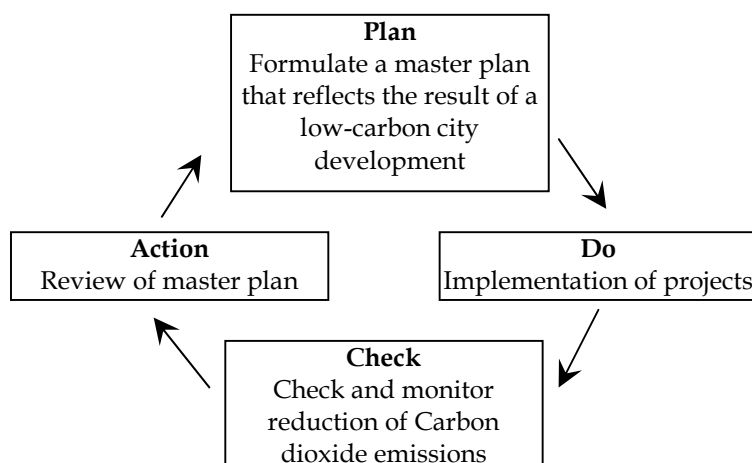
- Publicity is made through the media of radio, TV and newspaper; and
- Low-carbon knowledge contests are held to popularize low-carbon awareness and to provide guidance for people to adopt low-carbon lifestyles.

In addition, Qingdao has started the construction of a Low-Carbon Economy Experimental Zone. On 27 August 2010, GE and AECOM Group signed an agreement with Qingdao Municipal Government. According to the agreement, the three parties will jointly plan and design a cross-industry clean technology solution to be located in the Central Intelligence Island in Qingdao National Hi-tech Industrial Development Zone. This Low-carbon Experimental Zone will integrate the low-energy consumption power plant, smart grid system, low-carbon buildings, high energy-efficiency illumination and low-carbon medical infrastructure.

## **4.2 Japan**

The history of Japan's initiatives can be traced back to 1960s and 1980s in Kitakyushu City in combating pollution problems. Japan's approach is featured as having a comprehensive approach that emphasizes partnership of various stakeholders, including the government, business, civil society. The approach also utilizes a combination of various measures such as regulation, economic incentives, and public investment. Also of great significance is the long-term vision for urban structure and the central role played by city authorities. Japan, in the 21<sup>st</sup> century, entered a period of depopulation, economic slowdown, and decreased urban population density that hollowed out urban centers. In order to achieve sustainable development, Japanese cities, have adopted comprehensive strategies toward a compact city development, which focuses on building sustainable transportation system.

[Figure 5] Japan's Low Carbon City Development Guidance



#### 4.2.1 Eco-Model Cities: Kitakyushu, Kyoto and Toyama

In 18 January 2008, the Japanese Prime Minister Yasuo Fukuda's stated that "Japan will lead the international community by converting itself into a 'low carbon society' which will serve as a precedent for the world to emulate." In response, the Cabinet Secretariat of the Japanese National Government started the "Eco-Model City" (EMCs) Project, which aims at

- formulating and implementing action-plans, including concrete policies to achieve ambitious targets of greenhouse gas emission reduction;
- serving as pioneer cities, demonstrating specific actions that should be taken to achieve a low-carbon society;
- expanding Actions in Promotion Council of Low-Carbon Cities; and
- providing a platform for local governments seeking to create low-carbon cities.

[Table 5] Targets of 13 Eco-Model Cities

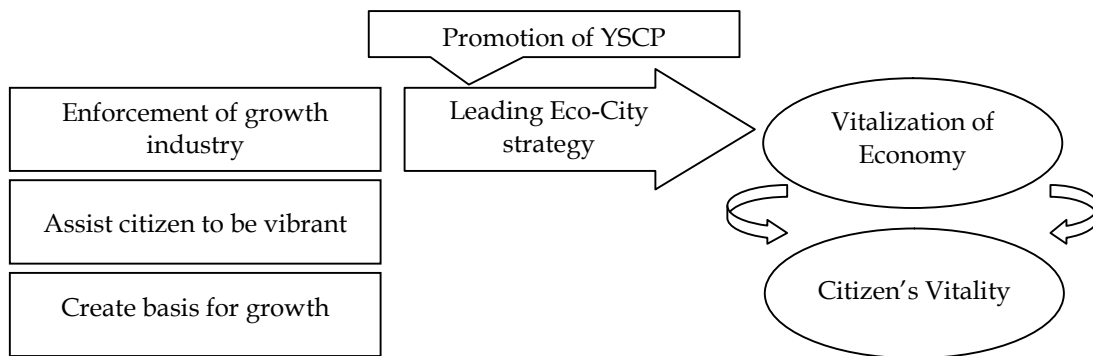
Cities	Population (thousand)	Area Size (sq.km)	Reduction Goal (mid-term)	Reduction Goal (by 2050)	Base Year
Kitakyushu	990	488	30% by 2030	50-60%	2005
Kyoto	1,470	828	40% by 2030	60%	1990
Sakai	840	150	15% by 2030	60%	2005
Yokohama	3,670	434	+30% per capita by 2025	+60% per capita	2004
Iida	110	659	40-50% by 2030	70%	2005
Obihiro	170	619	30% by 2030	50%	2000
Toyama	420	1,242	30% by 2030	50%	2005
Toyota	420	918	30% by 2030	50%	1990
Shimokawa	3,900	644	32% by 2030	66%	1990
Minamata	29	163	33% by 2020	50%	2005
Miyakojima	55	205	30-40% by 2030	70-80%	2003
Yusuhara	4,000	237	50% by 2030	70%	1990
Chiyoda	45	12	25% by 2020	50%	1990

Source: Regional Revitalization Bureau, Cabinet Secretariat, Government of Japan, 2009

## 4.2.2 Yokohama City

Yokohama is the capital city of Kanagawa Prefecture. With a population of 3.6 million, it is the second largest city in Japan by population after Tokyo and most populous municipality of Japan. It lies on Tokyo Bay, south of Tokyo, in the Kant region of the main island of Honshu. It is a major commercial hub of the Greater Tokyo Area. It is also a city committed to be a pioneer of low carbon, green city. In 2008, Yokohama City was selected by the National Government as one of the 13 *Eco-Model Cities*; and in 2010, Yokohama became the only Japanese city which was selected by the World Bank as one of the first six *Eco2 Cities*.

[Figure 6] Yokohama's Growth Strategy



Adopted from Nakajima T. (2011) "Transformation towards low carbon city infrastructure: the challenge of Yokohama, Environmental Model City", Suwon Conference on Low Carbon, Green Cities in North-East Asia, 17-18 October 2011, Suwon, ROK

Yokohama has formulated a New Mid-term Four-Year Plan (2010 ~ 2013), which clearly specifies its targets to reduce GHG emission by 25 percent by 2020 and 80 percent by 2050. The Four-Year Plan identified Yokohama Growth Strategy, which consists of three components: enforcement of growth industry, assistance of its citizen to be vibrant, and creation of a basis for growth. Related to this Eco-city Strategy, Yokohama formulated its Environment Cutting Edge City Strategy. This Strategy aims at transforming Yokohama into a low carbon society by providing business opportunities through creation of new demand to encourage technical innovation of local SMEs for vitalization of its economy. Eco-friendly activities and diffusion of electric vehicles have been strongly encouraged for households; meanwhile, renovation of eco-friendly infrastructure and increased investment by environmentally-friendliness have been promoted in the public sector. In addition, Yokohama Smart City Project (YSCP) has been implemented, with CO<sub>2</sub> expected to be reduced by 64,000 tons by 2014. In the course of implementing the YSCP, 27MW solar heating, energy management system for 4,000 homes and building energy management systems for 160 million square meters will be installed. YSCP emphasizes,

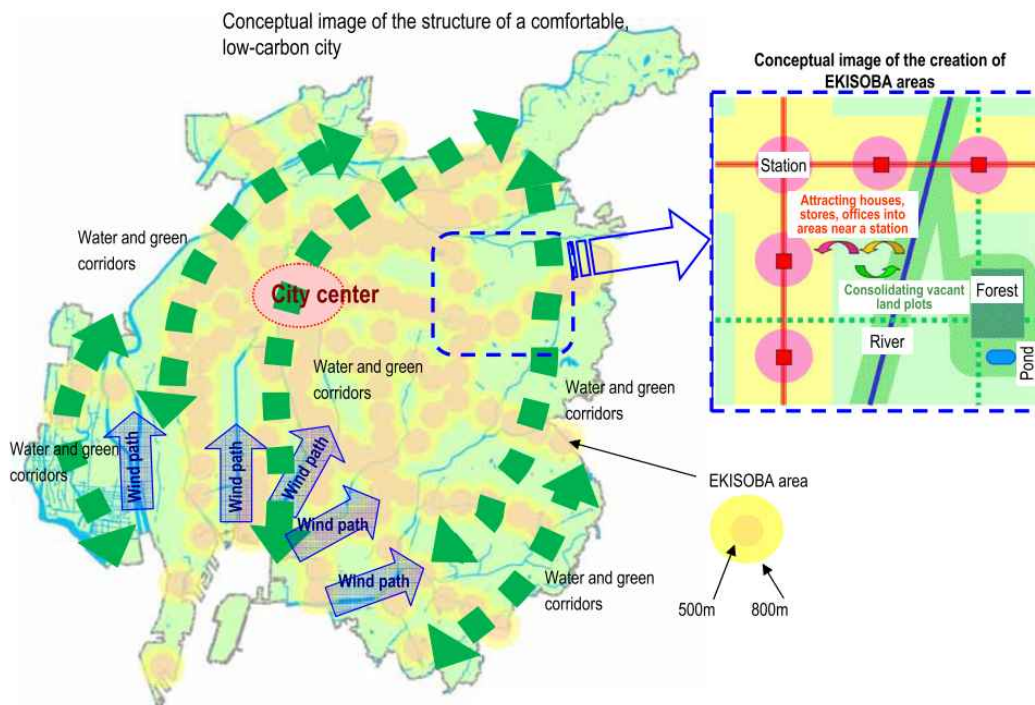
- introduction of renewable energy such as sunlight, solar heat, and wind power;
- research and development of energy management system; and
- utilization of electric vehicles and linkage with Energy Management System.

### 4.2.3 Nagoya City

Located on the Pacific coast in the Chubu region on central Honshu, Nagoya is the capital of Aichi Prefecture and is one of Japan's major ports. It is also the center of Japan's third largest metropolitan region. The geographic position of Nagoya is unique. The Fujimae Tidal Flat in Nagoya Port is one of the largest stopovers for migratory birds in Japan. Once under consideration to become Nagoya's landfill site, the tidal flat is now a protected area. Based on its local conditions, Nagoya City has developed the "Low-Carbon City 2050 Nagoya Strategy" and long-term strategies for supporting biodiversity and water circulation. The Strategy aims to become an environmental capital through citizen participation and collaboration. The goal is to work on transforming Nagoya into a comfortable, low-carbon city. The local government of Nagoya City is especially keen on emphasizing the local citizens' participation.

Due to the effects of climate change and the urban heat island effect, the average temperature in Nagoya City continues to rise at the rate of 2.8 degrees centigrade per century. This rate is more than 3.5 times faster than the world's average rate of 0.74 degrees centigrade per century. In order to mitigate this trend, the strategy sets the emission reduction goal at 25 percent by 2020 and 80 percent by 2050 from the 1990 levels for GHG emissions.

[Figure 7] Nagoya comfortable low-carbon city, conceptual image



Source: UNEP, 2011

The Strategy had set a comprehensive target and proposed four action policies:

1. EKISOBA Lifestyle: Create a living environment within walking distance of a transit station
  - Station-centered communities with a mix of houses, stores, offices, and other facilities are formed. Residents can travel by foot, by bicycle, or by public transit and enjoy convenience and proximity to nature.

- The city center is designed for easy walking and land use near stations is maximized while conserving the natural environment and using an area energy network.
2. Fu-Sui-Rhoku-In Lifestyle: Create a lifestyle to enjoy the natural environment
    - The city is designed to withstand natural disasters by the water-retaining capacities of the green spaces.
    - Vacant land plots are consolidated into areas around rivers, canals, and green spaces.
    - EKISOBA areas provide places to relax surrounded by streets and district trees. Outside the areas, a certain proportion of green districts and farms are restored and preserved, producing local seasonal foods.
  3. Low-carbon Living: Create energy and resource saving systems
    - CO<sub>2</sub> emissions reduction is sought in motorized vehicle control.
    - Comfortable living is based on energy conservation and passive climate control.
    - The main source of energy is generated locally.
  4. Participatory Community: Promote collaboration among residents for a low-carbon society
    - Advanced methods for visualizing environment-friendly activities, systems that allow people to benefit from their environmental activities have been established.
    - Many residents voluntarily participate in city development with an increased awareness of environmental issues.

### 4.3 Mongolia: Ulaanbaatar

Located in north central Mongolia, Ulaanbaatar is the capital and largest city of Mongolia. With over one million people, the city represents 39 percent of the nation's total population. It also generates more than 60 percent of Mongolia's GDP. As a result, Mongolia's plans related to low carbon, green cities mainly focus on Ulaanbaatar alone. In fact, the sustainable development of *ger* areas in Ulaanbaatar is one of the critical development issues facing the country. The transition to a market economy and a series of severe winters have resulted in large scale migration of low-income families into the *ger* areas of Ulaanbaatar.

As a response to these challenges, in 2002, the "Compact City" concept of the Ulaanbaatar Master Plan 2030, was proposed to control spatial expansion and promote high-density development for the *ger* areas in Ulaanbaatar. The Master Plan advocates a "Compact City" concept through more efficient use of land: conversion of *ger* areas into more secure housing and gradual improvement of urban services for existing *ger* areas.

In 2007, Mongolian Parliament adopted the "*MDG-based Comprehensive National Development Strategy*", which recommended that spatial expansion in Ulaanbaatar should be controlled. Clearly, this policy emerged to control urban sprawl and to promote high density development.

Because the 2002 Ulaanbaatar Master Plan did not necessarily meet with the current situation featuring rapid population growth, rapid motorization and expansion of *ger* areas - there is a demand for modifying the Master Plan. In 2008, with assistance from JICA, "The Study on City Master Plan and Urban Development Programme of Ulaanbaatar City" was prepared. It aims to revise the current Master Plan in the target year of 2030, which would include countermeasures against expanding *ger* areas in response to rapid socio-economic changes. The realization of Compact City will create more convenient, clean and safe urban life in severe winter. To achieve the vision, four priority sectors are highlighted:

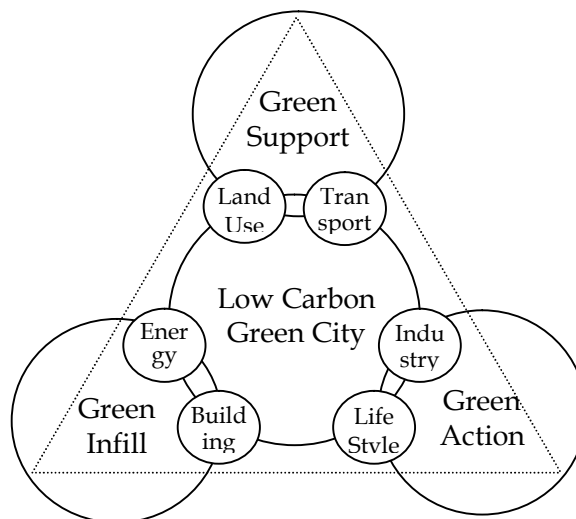
- Developing mass transit corridor, road network, and transport management system;
- Developing infrastructure for water supply, drainage, and heating;
- Improving ger areas and developing social housing for low-income households; and
- Institutionalizing urban planning and developing management.

In December 2009, government of Mongolia submitted a project proposal to reduce air pollution in Ulaanbaatar to the Millennium Challenge Account, which was approved in February, 2010. Considering that severe air pollution from the ger areas and seasonal heating due to combustion of raw coal in poorly insulated traditional gers, the objective of the project is increasing the usage of energy efficient appliances and supporting the development of renewable energies. The total number of the project beneficiary is 80,000 households in ger area of 5 districts of Ulaanbaatar Mongolia. Specifically, the Project creates a facility to fund financial incentives and technical assistance for adoption of cleaner, more efficient technologies and supports the introduction of wind energy into the national electric grid. The government of Mongolia, Ulaanbaatar Governor's Office and Xas Bank are assisting the project by promising to decrease the electricity cost by 50 percent during night time for the households who purchase energy-efficient stoves.

#### 4.4 Republic of Korea

Republic of Korea started to pay serious attention to environmental concerns in the early 1990s when its Environmental Agency was upgraded to Ministry of Environment. City planning has been integrated into a set of comprehensive national strategies for sustainable development, which consists of a well-established framework for long-term planning, both cross-sectoral and sectoral, and with a high degree of spatial diversification (planning at national, regional and local level).

[Figure 8] Korean concept of low carbon green city



*Adopted from Lee J. J. (2011) "Low carbon, green cities and its application to the Republic of Korea", as presented at Suwon Conference on Low Carbon, Green Cities in North-East Asia, 17-18 October 2011, Suwon, Republic of Korea.*



#### 4.4.1 Seoul

With a population of over 10 million, Seoul is the capital and the largest metropolis in Republic of Korea. It is one of the top cities promoting green growth in North-East Asia. Seoul has a target year of 2030 to decrease energy use by 20% compared to 2000 base year and to reduce GHG by 40 percent compared to 1990 base year. Furthermore, renewable energy is expected to grow from 0.6% (2004) to a level of 20% by 2030. The city has used a series of initiatives to transform itself into a low-carbon, green city, which emphasizes three sectors:

- Energy: Energy conservation and increase in renewable energy;
- Building: Energy efficiency and improvement in buildings; and
- Transportation: Improvement in public transit and promotion of green cars.

For the energy sector, the share of renewable energy use in Seoul is targeted to increase from the 1.5 percent in 2007 to 20 percent by 2030. In this regard, Seoul has selected Magok as an Eco-Friendly Energy Town, which will serve as a model for future eco-friendly, low-carbon development. The specific targets set by Magok town plan include 56.5 percent of renewable energy among all energy use and certification of all buildings as top grade in energy efficiency.

For the building sector, the initiative of energy efficiency for new buildings has been led by the public sector. For example, it is mandatory for the government owned buildings to have eco-friendly certification for all construction. The public sector is also recommended to invest 7 percent of total investment costs in renewable energy for the construction of all new buildings. This initiative is planned to be expanded to the private sector, where buildings that acquire excellent grade in terms of eco-friendliness will be eligible for tax discount of 5 to 15 percent. For existing buildings, a series of building retrofit projects led by the public sector have been implemented: 94 Seoul Metropolitan Government buildings and 31 public school buildings retrofitted their facilities to increase energy efficiency. The ultimate goal is to transform 60 percent of all buildings into green buildings by 2030.

In the transportation sector, the goal is to establish a convenient and efficient public transportation system in Seoul through the establishment of eco-friendly transportation infrastructure and delivery of eco-friendly green cars. Eco-friendly transportation infrastructure has been pursued with a total of 73.5km as bus-only lanes, an extensive urban train network and a subway system with a total of 286.7km. The target is to increase the level of mass transit usage from the 62 percent in 2006 to 75 percent by 2030. In terms of delivery of eco-friendly green cars, it is planned that by 2020, all taxis and buses will be replaced as electric vehicles. In addition, bicycle in daily life has been strongly encouraged in Seoul. The city has set the target to increase the Bicycle Ridership from 1.2 percent in 2006 to 10 percent in 2030. In order to achieve this target, the city has created 216 km of bicycle routes, 16 bicycle parking buildings, along with 19 bicycle elevators and bicycle-only cars in the subway system.

In addition to the abovementioned sectors, the Municipal Government opened Seoul City Hall Plaza in 2004, providing a small but significant green space in the heart of the city. The area, previously jammed by traffic, exhaust and noise, was transformed into an open town square park. It has succeeded in restraining traffic flow in this area and securing space for pedestrians. The Municipal Government also restored Cheonggyecheon stream, which is a historical stream that has run through Seoul for the last 550 years. The stream was covered with concrete in 1937

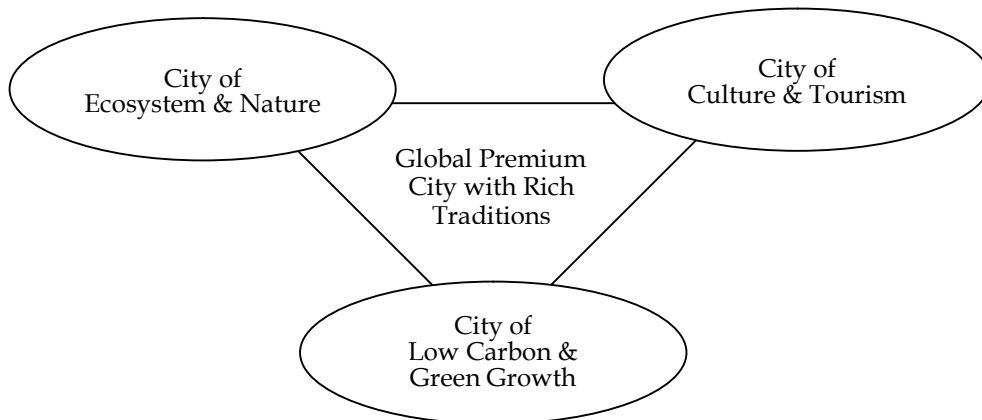
in order to make way for an elevated highway that would serve a daily traffic volume of 190,000 vehicles. The restoration of this 6 kilometer stream has made a great contribution to creating a nature-friendly image for the City of Seoul..

#### 4.4.2 Gangneung

Gangneung is a city located on the east coast of Republic of Korea. It has a population of 230,000. It is the first Low-Carbon Green Demonstration City, designated by central government of Republic of Korea. The vision set by Gangneung is to become world class example of a replicable low-carbon green city, showing urban energy consideration and emission reduction. It is expected that Gangneung will be the first low-carbon green city in Korea. In order to achieve such a vision, the strategies adopted by Gangneung include the following:

- creating the clean environment by preserving and remediating the natural environment;
- developing the city by utilizing traditional cultural assets and local resources;
- serving as a test bed city for cutting-edge green technologies;
- introducing low carbon options for transportation, housing and energy; and
- facilitating participation of citizens and encourage green lifestyle.

[Figure 9] Gangneung’s vision to be Korean’s first low-carbon green city



Adopted from Kim K. G. (2010) “Urban development model for the low-carbon green city: The case of Gangneung”, Master Planner for Gangneung Green Model City.

“Development Plan for Pine City – Gangneung Low-Carbon Green Demonstration City” for low-carbon green growth was reported to the President on 21 May 2009. The plan provides methods to achieve green growth in areas with excellent preservation of natural amenities but with lagging economic activities. Targeting an area of 17,545,000 square meters, the plan is composed of a *Comprehensive Plan* at strategic level and a *Neighborhood Development Plan* at tactical Level.

The *Comprehensive Plan* includes vision, goal, indicator, strategy, basic direction and land use plan for implementing a model city. It has four major components. First, the need for close cooperation among central government, local government, public and private enterprises, and local citizens is emphasized. Next, a new method for establishing low-carbon green city (includes adaptive design process, urban watershed planning, carbon and water footprinting, application of mitigation and adaption measures against climate change) is provided. The Plan

also provides suggestion on how environmental assets through ecological restoration of water, wetland, forest and coast should be enhanced during the development process. Finally, emphasis is made on setting concrete goals in the initial phase of development for successful ecological conservation and restoration.

## 5. Conclusion

The North-East subregion has witnessed tremendous economic growth in recent decades at the cost of environmental quality. According to the Global Footprint Network, the subregion is running an ecological footprint deficit of 0.5 hectares per capita, as compared to an average of 0.3 of the rest of the world. A justifiable alternative for averting this unsustainable pattern of growth for North-East Asian economies is to improve their ecological efficiency.

In the broader context of attaining higher eco-efficiency in the subregion, achieving low-carbon development in the cities is of utmost importance. As seen in the cases of cities included in this report, goals and objectives that are independently devised under different sectors come together as a whole in the urban dynamics of cities. Because the cities in North-East Asia have particularly great implication for the economic activities, social vitality, and environmental impact of their respective countries, a local plan to guide each of their development paths can be of national significance. The report has shown that establishment of a practical vision and effective mechanisms through which the goals can be delivered are most viable at the local level. In turn, cities' initiatives and experience can inform the broader policies.

Another characteristic of the North-East Asia is the considerable variation in natural resources endowment, economic growth, political structures and life styles across and within countries. It is therefore necessary to provide a range of development models of low carbon, green cities to reflect the diversity and to serve as reference for other development context. This makes exchange of diverse cases a mandatory aspect of minimizing inefficiency and inappropriate growth patterns. In order to optimize the learning experiences of cities, a platform for the local authorities is imperative. Because exchange among municipalities can be limited in scale, support and leadership from an international organization can deliver the critical momentum for galvanizing wide participation.

In this regards, NEASPEC has endeavored to convene cities in the subregion for reviewing current policies and programmes, building partnership for cooperation, and for placing the local-level dialogues in context of global challenges and solutions. Such efforts were materialized through the Suwon Conference on Low Carbon Green Cities in North-East Asia, which underscored the need to further accelerate the development and deployment of policies and programmes for low carbon, green cities in North-East Asia and ideas for establishing a subregional partnership for low carbon, green cities. The major roles of such partnership could include promoting transfer of low carbon development technique, training experts in low-carbon technique, facilitating joint research on methodology, sharing information of policies and successful practices, etc. In this regard, NEASPEC has commenced its role as a locus of information platform for collecting, analyzing and distributing strategies and plans for low carbon, green cities in North-East Asia, and as a catalyst for capacity development programmes among cities.