



**China Council for International Cooperation on
Environment and Development**

Council Member Paper

Ms. Veerle Vandeweerd



Ms. Veerle Vandeweerd

Director, Environment and Energy Group, United Nations Development Program. Member of the Council, Phase V

Veerle Vandeweerd directs the Environment and Energy Group within the Bureau for Development Policy of the United Nations Development Programme (UNDP), providing strategic direction and oversight to UNDP in mainstreaming environment, energy and sustainability into its development work in 166 countries. Dr. Vandeweerd also oversees the delivery of an extensive portfolio of projects and funds, including UNDP's Global Environment Facility and the Montreal Protocol unit, at the global, regional, national and local levels.

Before joining UNDP in 2007, Dr. Vandeweerd held leadership roles with the United Nations Environment Programme for 19 years based in Africa and Europe. Among her assignments with UNEP, Dr. Vandeweerd served as the officer in charge of the Policy Division of UNEP for several years, headed the Global Programme of Action for Protection of the Marine Environment, the Regional Seas Programme, the Global Environmental Monitoring System (GEMS), and initiated and directed the Global Environmental Outlook (GEO) report series. Dr. Vandeweerd worked for Belgium's (Flemish) government as Director of Environment Reporting, and was a lecturer for five years at the University of Lusaka in Zambia where she also conducted national surveys on African sleeping sickness. Dr. Vandeweerd holds a Ph.D. in biochemistry from the University of Antwerp, Belgium.



**China Council for International Cooperation on
Environment and Development**

Cities and Low-Carbon Development in China

Ms. Veerle Vandeweerd

CCICED Council member

2014 Annual General Meeting

December 1-3, Beijing, China

Author

Dr. Veerle Vandeweerd Special Advisor to the UN Global Compact;
Former Director of Energy & Environment Group, Bureau
of Development Policy, UNDP

Supporting authors

Ms. Samantha Anderson Policy Officer, Climate Change Team, UNDP China

Dr. Gørild Heggelund Head Energy & Climate Policy, INTASAVE Asia Pacific;
Senior Research Fellow & China Representative, the
Fridtjof Nansen Institute;

Formerly Senior Climate Change Advisor, UNDP China

Dr. Qiu Lin Postdoctoral Associate, Department of Geology and
Geophysics, Yale University

Acknowledgements

Special thanks go to the UNDP China Country Office for support and to the following for their valuable contributions and comments:

Dr. Knut Alfsen CCICED CHAD Supporting team member; Senior
Advisor/Senior Research Fellow
CICERO - Center for International Climate and
Environmental Research, Oslo

Mr. Jan Bakkes Senior Project Leader, Global and European Outlooks, PBL
Netherlands Environment Assessment Agency; Vice-
President of *The Integrated Assessment Society* (TIAS)

Mr. Michael Kuhndt Director, UNEP/Wuppertal Institute Collaborating Centre on
Sustainable Consumption and Production (CSCP)

Cities and Low-carbon Development in China

Summary of key findings

- **Major urban environmental issues facing China**

China's rapid urbanization has brought with it a number of environmental issues that need to be addressed, including: air and water pollution, land expropriations, food safety, public opposition to factories and infrastructure perceived as polluting, traffic congestion, energy insecurity, overreliance on coal, poor solid waste management, water and urban-land supply shortages, and urban sprawl. Many of them are linked to poor financing mechanisms for local governments; and many of them have been raised and addressed in the New-type Urbanization Plan (2014-2020) which is calling for a more balanced urbanization process, while at the same time planning for 130 million more urban residents by 2020.

- **Chinese cities are major sources of emissions and vulnerable to climate change**

Chinese cities are major sources of GHG emissions mainly because they are centres for industry. Emissions in China largely come from power generation and industrial production. Only about 20% of emissions come from transport, buildings and waste, a much smaller average than developed countries. However, Chinese cities are amongst the most vulnerable cities in the world to climate change. Several Chinese cities are among the top twenty cities vulnerable to sea level rise, many cities already experience severe flooding, and droughts. GHG emissions contribute to headline-making air pollution.

- **High-level policy and pilot programmes on climate change already underway**

China's National Climate Change Programme was launched in 2007. Targets for reductions in GHG emission intensity have been laid out in subsequent five-year plans. Various pilot projects in low-carbon development have been launched include carbon trading markets, low-carbon cities, eco-cities, and industry-research alliances for technology innovation. Improved energy efficiency requirements for power plants, buildings and automobiles have helped slow the rate of emissions growth. Financing plans that address climate change remains uneven and a challenge to implementation.

China's National New-type Urbanization Plan and Climate Change Adaptation Strategy may lead to significant reductions in emissions and greater resiliency in the face of climate change, if well-implemented. Both plans identify interventions such as protection of water sources and environmentally sensitive areas, curbing sprawl and more rational land use.

- **Many opportunities to learn from successful examples of low-carbon development in other cities**

Cities around the world have adopted a variety of mechanisms to encourage low-carbon development. These include policy and planning tools, financing for low-carbon development, technological interventions, carbon trading markets, use of international financing mechanisms, and international peer learning and capacity building networks.

Summary of the priority policy recommendations

Recommendation 1: Holistic, integrated, and coordinated low carbon, climate resilient approaches, strategies and implementation plans. Addressing climate change needs holistic and integrated approaches to avoid situations where actions taken in one area or sector are cancelled out in terms of net carbon emission reductions by actions not taken in other areas. For example if action is taken to curb industrial CO₂e emissions but at the same time emissions from transport continue unabated, the net overall result might still be an overall increase in CO₂e concentrations and associated impacts. Mitigation and adaptation are two sides of a same coin and need to be addressed simultaneously, emphasising co-benefits. A holistic and integrated way for low-carbon urban development can be based on life-cycle thinking and establishing carbon foot-printing for the city. This approach will take into account GHG emissions (and other environmental impacts) throughout all stages including planning, development, infrastructure construction, use-phase of buildings and transport systems, demolition and end-of.-life stages. Only by adopting life cycle approaches, emissions along the whole life cycle can be reduced. It also helps avoiding the shifting of emissions from one location to another (e.g. relocation of emission sources from one city to another). Finally, life cycle approaches will be necessary for cities to establish accurate emission inventories, the basis for emission trading systems.

Recommendation 2: New technologies and new natural resource management approaches must be deployed on a wide scale. Variations on- and deviations from-business as usual (BAU) are not enough to keep global temperatures from rising less than 2 degree Celsius. Urban areas as centres of innovation need to conduct research and spearhead the introduction of new and innovative technologies and natural resources management approaches to address sets of interconnected environmental problems.

Recommendation 3: An adaptive and iterative approach. The magnitude of the decarbonisation challenge is such that there is no quick or easy fix. Cities authorities need to approach the way cities are planned, managed and financed in an integrated, iterative and adaptive manner. Cost benefit analysis of alternative technological and management options need to be carefully considered, along with their financial, policy, and social implications. Changes in consumer behaviour must be promoted and technological innovation supported; all on a continuous basis and in an iterative manner.

Recommendation 4: A different type of urbanization to address the related issues of sprawl, congestion and segregation in Chinese cities is needed.¹

An approach that promotes compact, integrated and connected cities will not only generate emission reductions but will yield significant socio-economic co-benefits. This can be achieved by more efficient use of urban land at different scales, from the planning of metropolitan regions down to the design of new neighbourhoods, with a focus on flexible zoning and mixed land use and supported by transit-oriented urban development incentives. Urban planning needs to be coordinated at the municipal and regional levels and take into account the surrounding ecosystems. As the Chinese government already has stated the goal of promoting “people-centred development” as an important element for future development, urbanisation is an area where people-centred development can be implemented. This includes providing space for community-based innovation for urbanization, such as “living labs” initiatives which actively involve citizens in co-creation processes.

Recommendation 5: The capacity of local governments to address climate change in a holistic, integrated and transformative manner needs to be greatly strengthened.

Local government capacity building is a critical. Local officials have multiple obligations to the residents of their cities as well as to higher levels of government, and performance incentives in China tend to be skewed towards economic growth indicators. Demonstrating how low-carbon development can not only reduce GHGs but encourage economic growth, provide better services, or impact local pollution, may produce more widespread support for low-carbon development. Greater transparency in decision-making can support this goal.

Local officials need to work cross-department and engage other stakeholders from other public and private sector organizations to enhance the implementation of integrated, holistic urban development.

Recommendation 6: Re-evaluate financing mechanisms for local government investment in green infrastructure

Current structures for city financing are out of date and need to be re-evaluated at all levels of government. Local governments are too dependent on land sales for financing expenditures which encourages sprawl. Other disincentives to low-carbon choices need to be examined and discontinued- for example, encouraging car use and destroying bicycle infrastructure to support the automobile industry. Many cities around the world are using creative approaches to incentivize low-carbon development which could be applied in China. Local government investment mechanisms for green infrastructure are closely related to government procurement systems and practices. There is huge potential for local governments to shift local municipal government spending towards Green Financing. Significant energy savings can

¹ Based on informal discussions with UN Habitat staff member.

be achieved through shifting government procurement in the area of government buildings, vehicle fleets and energy saving office equipment.

Recommendation 7: Engage with national and international networks

Networks can support local governments to build capacity and learn from best practices, and in some cases, obtain financing. Chinese cities, especially smaller ones, are less engaged in international networks than many cities around the world and should be supported and encouraged to take advantage of the upsurge in city-to-city networking currently underway globally.

Contents

Summary of key findings	3
Summary of the priority policy recommendations.....	4
1. INTRODUCTION.....	8
2. CHINESE CITIES.....	8
2.1. Urban issues in Chinese cities	8
2.2. Climate change in Chinese cities	10
3. TACKLING CLIMATE CHANGE IN CHINESE CITIES	12
3.1. Taking action	12
3.1.1 Urban transportation	12
3.1.2 Green buildings	12
3.1.3 Low-carbon cities	13
3.1.5 Financing	14
3.1.6 Emissions trading system	15
4. PLANNING FOR CLIMATE CHANGE IN CITIES	16
4.1. The National New-type Urbanization Plan	16
4.2. Adaptation	17
5. PEER-TO-PEER LEARNING	18
5.1. Policy and planning	18
5.2. Financing	19
5.2.1 Fiscal instruments for low-carbon financing in cities	20
5.3. Innovative technological solutions	24
5.4. International initiatives	25
5.4.1 Urban NAMA's	25
5.4.2 City networks, technical and capacity support	26
6. CONCLUSION AND RECOMMENDATIONS	26
APPENDICES	32

1. INTRODUCTION

The majority of humanity became urban dwellers in 2010. 70% of the world's people are expected to live in cities by 2050. China has been at the centre of the world's rapid urbanization processes over the past seventy years, moving from a population that was 11% urban in 1949 to 52% in 2012.

Cities occupy 2% of the earth's land mass, account for 67-76% of global energy use and 71-76% of global CO2 emissions.² They also produce about 70% of the world's GDP and are centres for innovation, creativity and new ways of thinking about the world.³ Cities deal with the provision of basic human needs every day, and as a result are at the forefront of thinking about how environmental degradation, economic deprivation and social unrest interconnect. Therefore, cities are also often leaders in implementing solutions to address climate change. City builders in government, the private sector and civil society recognize that sustainable cities are also more liveable cities, with environmental protection and climate change mitigation efforts providing numerous economic and social co-benefits to city residents.

2. CHINESE CITIES

2.1. Urban issues in Chinese cities

The UNDP China office, collaborating with the Chinese Academy of Social Science, compiled the *China National Human Development Report 2013* focusing on ecological civilization and sustainable and liveable cities. As discussed in the report, not only has China's population recently become majority urban, but cities are also major drivers of China's growth and economic success. Urban areas contribute 56.3% of GDP which is expected to increase to 75% by 2030.⁴

In the middle of this urban transformation, the Chinese government has gradually moved away from a narrow focus on economic growth and is increasingly emphasizing the quality of development. China's *National New-type Urbanisation Plan (2014-2020)* sets out a 'human-centred' approach to increasing urbanisation through extending urban public services to migrant workers, relaxing restrictions on migration to small and medium sized cities, improving public engagement of migrants, improving basic social security measures, rational use of land to limit sprawl and overly dense construction,

² International Panel on Climate Change Working Group III. *Human Settlements, Infrastructure and Spatial Planning*. 13 December 2013, p.4

³ Global Commission on the Economy and Climate. *The New Climate Economy, Better Growth Better Climate*, 2014. <http://newclimateeconomy.report/>

⁴ United Nations Development Programme. *China Human National Development Report 2013*. Beijing, 2013, p. 26

increasing affordable housing, improving transportation within and between cities, and an overall ‘green’ approach to city infrastructure.

Concepts such as ecological civilization, the circular economy, the low-carbon economy, a balanced economy, quality of life and social concerns are spearheaded in China and regularly appear in public statements and media campaigns. These concepts are also extensively discussed in the 12th Five-Year Plan (2011-2015). Recent amendments to the Environmental Protection Law, the new air pollution plan, and the expected soil, land and water pollution plans are all demonstrating a commitment to improving quality of life in China.

Nevertheless, China faces considerable challenges in urban areas, include, but not limited to:⁵

Pollution

Air pollution may now be the leading cause of premature death in China. One third of Chinese cities do not meet national Grade II (World Health Organization) standards. When measuring for fine particulate matter or PM2.5, four-fifths of cities do not meet standards. Smog days are increasing, in particular in the Beijing-Tianjin Hebei region, the Yangtze River Delta and the Pearl River Delta, although nationally air quality has improved somewhat since the 1990s. 227 out of 468 cities surveyed experience acid rain, which accounts for 48.5% of total rainfall.

90% of urban water areas and 65% of drinking water supplies are contaminated with urban sewage, domestic and industrial waste, fertilizers and pesticides. Compliance with national standards is at only 46%. Water pollution accounts for around 50% of negative pollution events affecting the environment.

Food safety is an issue of greater and greater concern to Chinese citizens. Laws are in place but often suffer from lack of compliance, poor enforcement, weak penalties, and lack of general knowledge about food safety.

Transportation

Rapid expansion of car ownership coupled with poor traffic management, underdeveloped road networks and lack of sidewalks and infrastructure for non-motorized transportation, has resulted in extreme levels of congestion, and contributes to air pollution.

Water

Two-thirds of cities in China face water shortages with a total annual shortfall of 5.8 billion cubic meters. Cities such as Shanghai and Tianjin are dealing with ground subsidence due to overpumping of ground water. In coastal cities, subsidence exposes aquifers to greater risks of salinization.

Urban leakage wastes about 20% of piped water, and industrial recycling is low at about 60% compared to 85% for developed countries. Urban and industrial water shortages are

⁵ For a detailed overview, see *ibid.*

impacting ecosystems as large-scale engineering projects are put in place to divert water from south to north China.

Land and built environment

Urban land supply is limited. Nearly all land in the south-eastern coastal cities is built up and land use intensity in some cities has exceeded the international warning level of 30%. Shenzhen, for example, is at 46.5%. Average per capita construction area is 133 sq. m. above the national planning standard of 120 sq. m. (lowered to 100 sq.m. in the new urbanisation plan) and the world average of 83. At the same time, Chinese cities are starting to sprawl on their peripheries, due to local governments' reliance on land development for income, resulting in low-density, high-carbon land use patterns and the unnecessary urbanization of rural land.⁶

Energy, sewage and waste

Energy demand is high and supplies are tight. An overreliance on coal has severely impacted air quality. The overall use of renewables and energy efficiency is generally low and some Chinese cities experience hardship due to lack of energy supplies.

Sewage discharge is currently at 41.6 billion cubic meters with only 23% treated to national standards. The rest is mostly directly discharged into rivers impacting water quality.

Chinese cities currently produce 150 million tons of solid waste annually (out of a total of 1 billion tons for the whole country), increasing at a rate of 10% each year. 90% goes to landfills, 7% is incinerated and the rest is composted. Many towns do not have proper disposal facilities and among 600 large and medium cities, two-thirds experience problems with build-up of waste.

2.2. Climate change in Chinese cities

According to the UNDP China National Human Development Report 2013, China's capacity to address climate change is weak, particularly in small and medium-sized cities with poor infrastructure and planning. Climate adaptation and mitigation are long and systematic projects that require scientific and technological inputs, appropriate policies and sufficient supporting capabilities. China has strong scientific and policy inputs at the national level, but still lacks capacity at the local level.

In 2012, China's per capita carbon emissions were 7.1 tons, similar to the European Union's 7.4 tons and much lower than the United States' 16.4 tons per capita.⁷ However, due to its population size, China is responsible for about a quarter of the world's

⁶ Axel Baeumler, et. al. *Sustainable Low-carbon City Development in China*. World Bank, 2012, pp. xl-xli

⁷ PBL Netherlands Environmental Assessment Agency. *Trends in Global CO2 Emissions*. The Hague, 2013, p.4. http://edgar.jrc.ec.europa.eu/news_docs/pbl-2013-trends-in-global-co2-emissions-2013-report-1148.pdf

emissions, making it the largest single global emitter.⁸ Chinese cities are strong contributors to carbon emissions as they are important centres for industrial production. Emissions largely come from power generation and industrial production, with only about 20% from transport, buildings and waste, much smaller than developed country averages.⁹

Climate change has caused the Chinese coastal sea level to rise by 2.7 millimetres annually over the last three decades.¹⁰ This, combined with typhoons, has caused severe storm surges and tidal disasters in coastal cities. Global sea level is expected to rise between 18 to 59 centimetres by the end of the 21st century and cause more serious threats and damages.¹¹ Saltwater intrusion into freshwater aquifers due to sea level rise has already been documented in the Yangtze River Basin.¹²

Recent evaluations have suggested that Shanghai and Guangzhou were in the top ten cities most vulnerable to flooding, and China is one of the countries most vulnerable to sea level rise and storm surges.¹³ China has an estimated 130 million people living in areas at risk for sea level rise, by far the largest concentration in the world. A recent study by the World Bank puts five Chinese cities in the top 20 cities in the world most likely to have their economies affected by climate change (see Appendix 1).

China already suffers from heavy precipitation events. For example, in July 2012 in Beijing, heavy rainfall caused 79 deaths and 10 billion RMB in economic losses. Intensive construction, mining, stone exploitation, and real estate development have contributed to soil erosion and sudden floods and landslides.

China has seen its arid and semi-arid regions grow over the last half-century. With climate change leading to increased drought this trend is likely to continue. Sandstorms already contribute to poor air quality in northern China.

Many Chinese cities are already on a high carbon-emission growth path. The need for action is strong, but fortunately local sustainable development and carbon emissions reductions are closely linked.¹⁴ For example, many solutions for air pollution are also solutions for carbon reduction. China has taken a strong policy stand on climate change and sustainable urbanization. The challenge now is to implement those policies widely and equitably and develop and test new and innovative approaches and technologies.

⁸ International Energy Agency. *CO2 Emissions from Fuel Combustion: Highlights*. 2013. <http://www.iea.org/publications/freepublications/publication/co2emissionsfromfuelcombustionhighlights2013.pdf>

⁹ Axel Baeumler, op.cit., p. xi

¹⁰ http://www.soa.gov.cn/zwgk/hygb/zghpmgb/2011nzghpmgb/201212/t20121217_22804.html

¹¹ Intergovernmental Panel on Climate Change. *Climate Change: Synthesis Report*. 2007. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf

¹² ibid

¹³ UN Human Settlements Programme. *Cities and Climate Change Global Report on Human Settlements*. 2011, p.68.

¹⁴ For an overview, see http://www.climatechange2013.org/images/report/WG1AR5_SPM_FINAL.pdf

3. TACKLING CLIMATE CHANGE IN CHINESE CITIES

3.1. Taking action

China has set a number of hard targets for carbon reduction. Efforts at the local level are driven by central government priorities. The Government launched *China's National Climate Change Programme* in 2007, followed by an announcement in 2009 which set hard targets for CO₂ emission reduction per unit of GDP, renewable energy targets and reforestation targets. By 2020 CO₂ emission per unit of GDP is to be reduced by 40-45% compared with 2005, non-fossil energy is to account for about 15% of the total primary energy consumption, forest area is to increase by 40 million hectares and the forest stock volume is to increase by 1.3 billion m³ relative to 2005. The 12th Five-Year Plan set out actions to be taken during the FYP period (2011-2015) in order to achieve its 2020 goals.

China has shown early progress in urban emissions control and reduction in the following areas.

3.1.1 Urban transportation

In spite of China's motor vehicle inventory increasing 25 times in the last 30 years, emissions have only increased 12 times thanks to the rapid upgrade of emissions standards. Transport is still the fastest source of emissions growth with 26% of fuel combustion emissions in China coming from transport.¹⁵ The Chinese government is currently developing more than 5000 km of urban rail. Many municipalities are putting in place bike-share schemes, although overall bicycle use is down. However, 90% of the world market in electric bicycles is in China, and more than 200 million have been sold as of 2013. The government is also promoting the sale of electric cars through foregoing sales tax, providing subsidies, and prioritizing licenses.

3.1.2 Green buildings

China was among the first non-OECD countries to introduce energy efficiency into building codes. It established the National Green Building Assessment Standard in 2006, which provides indicators to measure efficient use of land and protecting green spaces, efficient use of energy, water and materials; safeguarding the quality of indoor environments. There is a national initiative to label building materials. Certified green buildings in China are still relatively low, with only about 80 million sq.m certified through the LEED programme and 40 million sq.m. certified under China's own Three Star program. In spite of inefficiencies and poor construction, Chinese buildings still use much less energy than developed country buildings, due mainly to lifestyle choices (e.g. fewer appliances, distributed air conditioning, less use of heating and cooling to save money). Maintaining this low-carbon lifestyle and combining it with improved design and construction in the building sector has the potential for significant emissions reductions.

¹⁵ Axel Baeumler, et. al. op. cit. p. xxvii

3.1.3 Low-carbon cities

Many cities in China have initiated eco-city projects such as the Dong-tan Eco-city in Shanghai and China's highest profile eco-city project so far, the Sino-Singapore Tianjin Eco-city. These eco-cities are designed to be sustainable communities that emphasize water and energy conservation, mixed-use development, and public transportation. However, there is scepticism with regards to the ultimate success of these developments as they are generally new greenfield residential developments targeted at higher income customers and located far away from employment centres. They are however providing learning opportunities for municipalities and developers in promoting mixed-use, environmentally friendly design.

A new low carbon cities and provinces programme launched by the national government, first in 2010, with a second batch in 2013, may prove more successful. This is the first attempt by the national government to implement its low carbon policies at the municipal level. The programme includes six low-carbon pilot provinces and 36 low-carbon pilot cities.¹⁶ The pilots have established task teams, implementation schemes, and set goals for carbon intensity reductions. In the future, they will be required to provide greenhouse gas emissions peak targets. The World Resources Institute has developed a GHG accounting tool for the pilots to use.¹⁷ The Ministry of Housing and Urban-Rural Development is assisting them in setting up indicators and developing demonstration projects related to green transportation, green utilities, green buildings and renewable energy.¹⁸

3.1.4 Energy¹⁹

Since 2007, the energy-saving targets and measures implemented by provincial governments and 1000 selected enterprises have been assessed annually, and made available to the general public. In the 11th FYP period, China shut down small coal-fired power generation units totalling 76.82 gigawatts (GW) of electricity, phased out 120 million tons (Mt) of backward production capacity²⁰ for iron making, 72-Mt for steel making and 370-Mt for cement production, promoted use of energy-saving lamps (over 360 million in total), and constructed a total of 4.857 billion m² energy-saving buildings.

¹⁶ **1st batch (2010):**Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, Baoding, Guangdong Province, Liaoning Province, Hubei Province, Shaanxi Province and Yunnan Provinces. **2nd Batch 2012:** Beijing, Shanghai, Shijiazhuang, Qinhuangdao, Jincheng, Hulun Buir, Jilin, Da Hinggan Ling Prefecture, Suzhou, Huai'an, Zhenjiang, Ningbo, Wenzhou, Chizhou, Nanping, Jingdezhen, Ganzhou, Qingdao, Jiyuan, Wuhan, Guangzhou, Guilin, Guangyuan, Zunyi, Kunming, Yan'an, Jinchang, Urumqi and Hainan Province

¹⁷ Peng Yan, "Making low-carbon cities a reality for China", *Cities Today Magazine*, 23 November, 2013

¹⁸ Baeumler, op. cit. p. 40

¹⁹ For more details, see the Government of China, 2009. *Second National Communication on Climate Change of the People's Republic of China*. 208 pp. Beijing.

²⁰ 'Backward production' is used by the Chinese government to refer to highly polluting or inefficient industrial production

In the same period, China saved about 630 metric tons carbon equivalent (Mtce), equivalent to CO² emission reductions of 1.46 Gigatons (Gt).

In 2005, the National People's Congress (NPC) adopted the *Renewable Energy Law*, which was revised in 2009. In 2007, the relevant departments under the State Council issued the *Medium and Long-term Plan for Development of Renewable Energies*, the *Medium and Long-term Plan for Nuclear Power Development*, and the *11th Five-Year Plan for Renewable Energy Development* among others. In recent years, the Chinese government has launched a series of financial and taxation policies aimed at promoting development of renewable energies, nuclear power and natural gas. See Appendix 2.

The 12th FYP has further reiterated renewable power generation targets. Targeted commitments, such as the almost US\$500 billion pledged to combat air pollution, is likely to help increase the pace of adoption of clean energy.

In addition to setting policies and targets, China is developing business-academic-government coalitions such as the China Strategic Alliance for CO₂ Capture, Utilization and Storage (CCUS) to develop innovative technologies that can be applied to low-carbon development. The Alliance was founded by China Huaneng Group, CNPC, Sinopec and State Grid Corporation of China, with guidance from the Office of Innovation and Social Development Division of the Ministry of Science and Technology. The Alliance consists of domestic enterprises, universities, research centres such as China United Coal, Tsinghua University, Peking University, the Chinese Academy of Sciences, Wuhan Geotechnical Mechanics and 28 other members. The Alliance was founded in 2013²¹. Its short term goal is to engage in research and demonstration projects on carbon capture and storage eventually scaling up so that by the end of 2030, the CCUS project will be able to capture 2 million tons/year (Mt/yr.) post-combustion CO₂ and 1 Mt/yr. pre-combustion CO₂ in coal-fired power plant, utilize 3 Mt/yr. CO₂ for enhancing oil recovery and 50000 tons/yr. CO₂ for coal-bed methane extraction and store 1 to 3 Mt/yr. CO₂ geologically²².

3.1.5 Financing²³

China's overall fiscal expenditure pressure on local governments has increased significantly and will present a major challenge for future local government expenditure on the low-carbon transformation of urban areas. Most expenditures in low-carbon sectors in China come from local governments (See Table 1).

Table 1: Expenditure Structure of the Central and Local Governments for Low-carbon Development (2011; unit: 100 million Yuan)

²¹ http://www.most.gov.cn/kjbgz/201311/t20131114_110387.htm

²² China Huaneng Group, et.al. 二氧化碳捕集、利用与封存产业技术创新战略联盟协议书 (*China Strategic Alliance for CO₂ Capture, Utilization and Storage (CCUS) Agreement*). 2013. Not published.

²³ The following is largely drawn from The Energy and Resources Institute et. al., *Low Carbon Development in China and India: Issues and Strategies (Advance Publication)*. 2014, pp. 93-144.

	Central government	Local governments
Urban and rural community affairs	11.62	7608.93
Energy conservation & environmental protection	74.19	2566.79
Transportation	331.11	7166.69
Agriculture, forestry & water affairs	416.56	9520.99
Land & meteorological services	231.61	1289.74

Source: Based on the China Statistical Yearbook 2012, Research Centre for Climate and Energy Finance CUFEE (2013)

The ability to finance low-carbon investments is unevenly distributed in China, with richer, eastern areas better able to finance infrastructure investment. See Appendix 4 for a comparison of per capita GDP and per capita low-carbon expenditure in China by city.

In addition, the current structure of municipal financing may work against investment in low-carbon urban development. Municipalities have few sources of funding with many fiscal responsibilities. They are barred from raising money on capital markets and tend to be highly reliant on land sales and land transfer fees for income. This encourages the sale of land on the urban periphery, which can lead to urban sprawl and poor or short-term development decisions that do not take into account overall commitments to lowering carbon emissions²⁴.

3.1.6 Emissions trading system

Since the emergence of the European Union Emission Trading Scheme (EU ETS) in 2005, there has seen a rapid growth in carbon trading systems. In 2013, the global carbon market reached to \$52.9 billion. Emission Trading is a relatively low cost market mechanism for emission reduction. Worldwide nearly 40 countries use carbon pricing mechanisms such as systems and carbon taxes or are preparing to implement them. For example, as the first mandatory cap-and-trade program in the United States to reduce carbon dioxide (CO₂) emissions from the power sector, the Regional Greenhouse Gas Initiative (RGGI) CO₂ Cap is projected to reduce 45% of CO₂ emissions in the region's power-sector compared with 2005 levels by 2020.²⁵ The Tokyo carbon trading system was established in April 2010. The caps will contribute to a 6% reduction in greenhouse gas emissions between 2010 and 2014 and a 17 % reduction from 2015 to 2019.²⁶ These experiences indicate that carbon pricing is a critical tool to address climate change and the momentum is growing world-wide to put carbon trading schemes in place.

In 2008 the Beijing Environmental Exchange, the Shanghai Environment Energy Exchange and the Tianjin Climate Exchange were established and marked the first steps

²⁴ Baeumler, op.cit. p.xix.

²⁵ <http://www.c2es.org/docUploads/rggi-brief-12-18-13-updated.pdf>

²⁶

https://www.kankyo.metro.tokyo.jp/en/climate/attachement/Result%20of%20the%20First%20FY%20of%20the%20Tokyo%20CT%20Program_final.pdf

taken by China to build a carbon trading system.²⁷ China's 11th Five-Year Plan supports the "gradually establishment of a carbon market". As the biggest supplier of Clean Development Mechanism (CDM) projects in the world, China's carbon market is mainly based on CDM projects and supplemented by small-scale voluntary carbon-trading projects. In January 2012, the National Development and Reform Commission (NDRC) officially approved carbon the trading pilots in Beijing, Shanghai, Tianjin, Chongqing, Guangdong, Hubei and Shenzhen. These seven Pilot Carbon Emission Trading Schemes (ETS) serves not only as a policy tool to meet China's goal to reduce carbon intensity by 40-45% from 2005-2020, but also to gain lessons learned for a national carbon market, to be launched during the 13th "5 Year Plan" for development 2016-2020.²⁸

Each carbon market in China is unique with the objective of testing out different methods and tools. The pilot phases will be ended in 2016 and all the markets will be reassessed by then. China's carbon market is the second largest in the world after the EU ETS. According to Mr. Xie Zhenhua, Vice Chairman of NDRC, in an interview with China Daily, as of May 2014, Chinese companies have traded over 3.85 million tCO₂ of emissions quotas and these have sold for 20 million USD.²⁹ China is also planning to for the first time legalize the cross-regional ETS among Beijing, Tianjin and Hebei province by 2015. Although the seven markets are up and running, uptake is slow. For example, after the launch of the Shenzhen market, there was one month without any trading according to the CEO of Shenzhen Carbon Exchange. Appendix 6 lists some of the major international emission trading schemes.

4. PLANNING FOR CLIMATE CHANGE IN CITIES

4.1. The National New-type Urbanization Plan³⁰

The National Plan for New-type Urbanization (2014-2020) (referred to as "the plan") was presented on 16th March, 2014 by the Central Committee of the Communist Party of China and the State Council. The plan is comprehensive, covering a full range of issues under the responsibilities of many different government departments. The plan focuses on social and environmental issues, prioritizing the quality of urbanization ahead of economic factors.

Human-centred approach: The plan puts urban inclusiveness at the centre of the program, in an effort to steer the country's urbanization onto a human-centred and environmentally

²⁷ For an overview, see the Chinese Academy of Social Sciences. 2011. *Green Book of Climate Change: Annual Report on Actions to Address Climate Change (2011)*.

²⁸ The Energy and Resources Institute et.al., op.cit. p.121-23

²⁹ "China becomes world No. 2 carbon trader", *Xinhua*, 11 June 2014

http://usa.chinadaily.com.cn/business/2014-06/11/content_17577539.htm

³⁰ For more details, see http://www.gov.cn/zhengce/2014-03/16/content_2640075.htm

friendly path. This focus pays special attention to putting migrant workers and their welfare on par with the registered urban population. The plan states the country should guide a reasonable flow of population, help rural residents become urban citizens in an orderly manner and make basic urban public services available to all permanent urban residents, through *hukou* reform.

City layouts: According to the plan, China will also optimize city layouts by enhancing the leading role of major cities, increasing the rational development of urban clusters, increasing the number of small and medium-sized cities, and improving the service functions of small towns. More public resources will be put into infrastructure, construction and public services in small and middle-sized cities. The systems of household registration, land management, social security, taxation and general administration will also be improved. The plan also outlines intentions to transfer industry from coastal areas to the middle and west part of China, cultivating suitable towns into middle-sized cities, especially along the “silk road area”.

Ecological civilization and intelligent city: Green production and consumption will become the norm in the urban economy, and clean air and safe drinking water will be available for all. Energy saving products, recycling products and green building will be mainstreamed into the economic development of urban areas. The goal for developed land is 100 sq.m. per capita. More resources will be invested into the new generation of information technology.

4.2. Adaptation³¹

China set out its national strategy for climate change adaptation in 2013, guided by the 12th 5-year plan. The Strategy is set to last until 2020.

Although China is already implementing several adaptation measures, the new Strategy has identified a number of gaps that need to be addressed. It focuses on infrastructure, agriculture, water resources, coastal zones and marine waters, forests and ecological systems, tourism and other industries, and human health.

The Strategy lays out strategies for three different urban regions:

Eastern urbanized areas

Urban drainage systems and capacity are to be improved, impervious surfaces reduced and green space increased, water features such as rivers and reservoirs protected to improve rainwater storage, waterlogging and flooding reduced and saltwater intrusion into estuaries addressed. Industrial restructuring will help water shortages. Infrastructure standards will be raised and monitoring improved to withstand extreme weather events including sea level rise, storm surges and typhoons.

Central urbanized areas

³¹ See <http://www.gov.cn/gzdt/att/att/site1/20131209/001e3741a2cc140f6a8701.pdf>

Cities will improve flood and drought management, and restore and protect green space, water and wetlands. Urban infrastructure and public services will be improved to attract and manage higher populations as population growth is directed to cities with greater environmental carrying capacity. Urban health care systems will be improved to address prevention and control of schistosomiasis and other vector-borne diseases.

Western urbanized areas

Water saving measures including more green space, less impervious surfaces, groundwater recharge, etc. will be improved. Ecological barriers against wind and sand will be consolidated around north-western cities, and water-consumptive industries limited in drought prone areas. Construction is to be balanced and populations relocated from vulnerable places.

The Strategy identifies a number of climate change adaptation pilot projects including in urban areas. A Shanghai project examines changing urban infrastructure construction standards to cope with extreme weather events, a Hebei project integrates urban water facilities to address severely over-exploited groundwater, land subsidence, seawater intrusion, etc. and a project in Chongqing focuses on the application of best practices in safeguarding human health under climate change.

5. PEER-TO-PEER LEARNING

Municipalities around the world have taken steps to mitigate their greenhouse gas emissions through a wide range of approaches. Some of these have been on an ad hoc basis in response to external funding or opportunities (e.g. the investments in public transportation that usually accompanies large-scale sports events such as the Olympics or the World Cup), and some have been the result of systematic planning for greenhouse gas reductions (e.g. cities who joined ICLEI's Cities for Climate Change Partnership), or a combination of both (Vancouver's green infrastructure investment). More and more experts are advocating for an integrated approach to implementing sustainable city initiatives and cities are responding with more comprehensive, integrated planning and policies to maximize their investments.

5.1. Policy and planning

Local government policy has an important impact on carbon reduction. It creates an enabling environment for either sustainable or unsustainable city development. Municipal policy operates within the constraints of policies set by higher levels of government and their own jurisdictional responsibilities. Municipalities' powers and funding are generally limited, but still have significant influence over land use patterns, transportation options, types of buildings, and waste disposal, with major impact on energy and consumption of other resources. Because a municipality is the level of government more closely connected to people's daily lives, they are in a position of being able to provide

leadership and education in an immediate and visible way, in particular through their own actions. When people enter a new green community centre or experience solar street lights they are able to see energy efficiency in action. When they are engaged in planning decisions, they are able to influence and understand changes to their city.

Effective planning is an important tool municipalities have for achieving change in their communities. Some municipalities have developed sustainability plans while others have incorporated sustainability principles, including climate change mitigation efforts, into their regular planning processes. It is becoming more and more apparent that plans that are able to connect different urban systems either comprehensively or for key areas such as land use and transportation can, if implemented, have a considerable impact on GHG reductions, increased sustainability and liveability.

Policy interventions currently in use by local governments around the world directed towards sustainability and climate change mitigation and adaptation include:

- Integrated, participatory planning
- Mixed-use zoning
- Urban growth boundaries
- Urban greening/agriculture
- Green building codes
- Sustainability checklists
- Density policies
- Prioritizing public transportation
- Waste diversion
- Green accounting & procurement measures

See Appendix 5 for details and examples of each measure.

In addition to proactive policies, municipalities need to be aware of and integrate their climate change policies with those in place to promote more sustainable development. Municipalities need to address such issues as out-of-date zoning that does not allow mixed-use development, fee structures that encourage waste (e.g. charging less for bulk water use, or garbage disposal), to road construction standards that discourage walking. Departments often have different goals and priorities which may be at cross-purposes. One of the important impacts of sustainability or carbon plans that are developed through multi-stakeholder processes is that they foster communication between departments and help set common goals.

Policies are of course only effective if they are implemented. The next two sections explore financing for the implementation of policies that impact cities' efforts to mitigate climate change, and technical options that contribute to more sustainable cities.

5.2. Financing

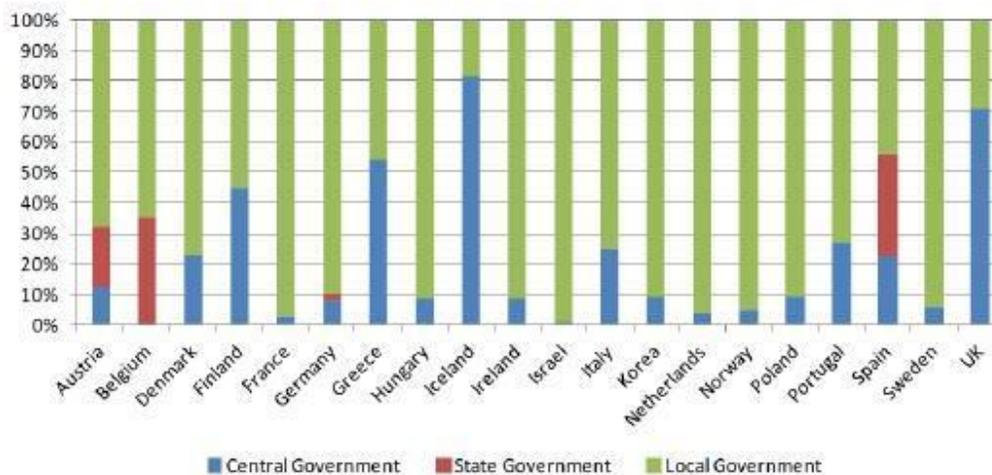
Effective, efficient and diversified financing is an important tool to ensuring low-carbon development and the transformation of cities. However, cities vary in emissions and

economic structure & scale, comparative advantages and development trends. Appropriate financial tools and structures will depend on local conditions.

The breakdown of investment in infrastructure and fixed assets for environment protection and green economic development varies from country to country. In some countries, 90% of these investments come from local governments (e.g. France, Germany, Hungary, Ireland, Israel, South Korea, the Netherlands, Norway, Poland and Switzerland), while in others central governments will cover from 25% (Austria, Belgium, Denmark, Italy, and Portugal) to over 50% (Greece, Iceland, Spain and the UK) of costs.³²

In some cities, low carbon investment accounts for a sizable amount of local government expenditures, in some cases up to 40%. Graph 1 illustrates the percentage of central government expenditure and local government expenditure on fixed-asset investment in the environmental protection sector in major OECD countries.

Graph 1 -- The Percentage of Central Government Expenditure and Local Government Expenditure on Fixed-Asset Investment in the Environmental Protection Sector in Major OECD Countries (2009)



Source: OECD (2012)³³, based on National Accounts Database, 2009

5.2.1 Fiscal instruments for low-carbon financing in cities

International experience with fiscal instruments can provide sound reference for the design and reform of Chinese fiscal instruments. Table 4 summarizes key fiscal instruments which may be applied to the low carbon financing by local governments. Instruments include taxes, fees and transfer payments from the central government.

Table 3 -- A Summary of the Fiscal Instruments for the Low Carbon Financing of Local Governments by the Sources of Fund and the Key Sectors

	Transportation	Building	Waste Recycling and Disposal	Energy

³² The Energy and Resources Institute et.al., op.cit., p. 96

³³ O. Merk, S. Saussier, S., C. Staropoli, E. Slack, J-H Kim, J-H., *Green Urban Infrastructure*, OECD Regional Development Working Papers, October, 2012, p.14. http://www.oecd.org/gov/regional-policy/WP_Financing_Green_Urban_Infrastructure.pdf

Taxes	Consumption Tax, Vehicle and Vessel Tax	(Property Ownership Tax)	(Property Tax)	(Energy Tax) (Carbon Tax)
Fees	(Congestion Fee) Parking Fee (Highly Travelled Road Fee)	(Construction Fee) Land Transfer Fee (Development Fee) (Excessive Plot Ratio Fee)	Property Management Fee	Electricity Surcharge
Transfer Payment of the Central Government	Current Account Expenditure Subsidies Special Funds [Earmarking of Tax Revenues]			

Note: the policies in brackets are those which have been put in place in other countries but have not yet been adopted or widely applied in China.

Source: Adapted from The Energy and Resources Institute et.al. 2014. *Low Carbon Development in China and India: Issues and Strategies (Advance Publication)*

Property tax is the main source of revenue for local governments in the OECD countries. This type of taxation has an impact on land use, urban plot ratios and the speed of urban development. Several jurisdictions have experimented with other types of taxation and fees to encourage low-carbon development, including limiting car use and increasing density. Advocates for denser cities have long noted the benefits of limiting sprawl, protecting green space, and concentrating enough people to make public transit feasible.³⁴ Dense multifamily developments can also make alternate energy arrangements feasible, such as district heating, combined heat and power, increased energy efficiency through passive design and waste heat recovery.³⁵ Other benefits from compact development include less money spent on infrastructure³⁶ and walkable, lively neighbourhoods with many amenities.

Table 4 gives several examples of municipal financial tools specifically designed to encourage low-carbon development. For example, in 2010, France imposed a tax on building projects whose plot ratios³⁷ are lower than the statutory level to discourage sprawl and the City of Austin, Texas, U.S.A. levied a tax on motor vehicles for their use of public roads based on the assessed per-household mileage of the vehicles, which has also encouraged density in the city. Canada collects a gas tax at the federal level which goes into a fund for green municipal infrastructure spending combining both taxation and transfer payments from higher levels of government as a tool for low-carbon investment.

Table 4 -- Examples of Financial Tools in Developed Countries

³⁴ See http://unhabitat.org/wp-content/uploads/2014/05/5-Principles_web.pdf

³⁵ For a detailed overview, see the United Nations Human Settlements Programme, 2013. *Urban Planning for City Leaders*. 188pp. Nairobi

³⁶ <http://sustainablecities.net/our-work/services/infrastructure-costing>

³⁷ Also known as floor space ratios or floor area ratios, this is the ratio of a building's gross floor area to the size of the land on which it is built

Countries	Examples of Financial Tools in Developed Countries
Taxation	
France	Introduced in 2010 a tax policy which imposed certain low density tax on the building projects whose plot ratios are lower than the statutory level
The City of Austin, Texas, U.S.A.	Levied a tax on motor vehicles for their use of public facilities based on assessed per-household mileage of the vehicles, which played an effective role in preventing low density development.
Chicago	Earmarked 10% of its property tax revenue for the tax incremental financing (TIF), which covers 25% of the city's territory
Finland, Switzerland, UK	Some developed countries are imposing a certain percentage of carbon dioxide emission tax (carbon tax) on carbon dioxide emission from fossil fuels.
France, Poland, Sweden, Finland, Belgium	Some European countries have put a financial trading tax in place with part of the revenues dedicated to low carbon economic development.
Fees	
Copenhagen, Denmark	The extension of subways was funded by the fees collected from the real estate development projects in the Orestad district of the city.
The U.S. and Canada	The U.S. and Canada both levy different amounts of fees from the urban developers to fund the development of public facilities in the cities.
The St. Paul district of Brazil	Increase local fiscal revenue by selling the right to elevate existing houses, stipulating that new buildings whose plot ratios exceed the prescribed level must pay for such rights before starting construction.
London, Milan, Stockholm, Singapore	London, Stockholm, Singapore and Milan have all begun to collect this fee and have effectively reduced the emission of carbon dioxide (about 19.5%).
Singapore	In 1975 Singapore began to levy a road congestion fee at the amount of 3 Singapore dollars per day on the vehicles (excluding for public transportation purposes) which enter the 6-square-kilometer downtown area under control.
Singapore, Milan	Singapore and Milan levy fees for vehicles with a high emission levels.
London	London applies the congestion fee to the development of urban public transportation means.
New York and Los Angeles	New York and Los Angeles impose even higher parking fees in the highly congested areas, which effectively lessened traffic congestion.
Transfer Payments	
South Korea	South Korea began to implement its First Five-year Action Plan for Green Growth in 2009. Subsidies were provided to green urban development projects (undertaken jointly by the public and private sectors) in the amount of 20-30% of their project expenses, up to 50% for rail transportation projects, and 50-80% for the environmental protection service projects.

Source: Adapted from The Energy and Resources Institute et.al. 2014. *Low Carbon Development in China and India: Issues and Strategies (Advance Publication)*

In addition to the taxes, fees and transfer payments from higher levels of government that most local governments rely on for the bulk of their revenues, other financial instruments also play a role in low-carbon financing. Public financing options include a range of government funds or public-private funds that provide seed funding or loan guarantees to sectors or to companies that forward low-carbon development. Other options may include local financing platforms such as municipal bonds (possibly in partnership with higher levels of government or banks), public-private partnerships and philanthropic grants. Carbon markets are another source of financing for low-carbon development. The Clean Development Mechanism is the principle source of international carbon market financing while the domestic carbon market (see 3.1.6 for more details) has the potential to be a significant source of funding. Other market innovations have for the most part not reached China, but may include financial trading tools such as carbon forward transactions, carbon options, carbon futures, and securitized carbon financial products.

Table 5 -- A Summary of Financial Instruments Employed by Local Governments in Low Carbon Financing

Type	Content
Innovations in public finance	Policy funds
	Fiscally supported guarantee funds
	Special green funds for local governments
	Local financing platforms
	Public-Private Partnerships (PPP)
	Private grants
Carbon Financial Instrument	International carbon market
	Domestic carbon market
	Other market-based innovations
Innovations in traditional finance	Traditional credit
	Carbon assets pledge credit service
	International carbon factoring service
	Bonds
	Option tools
	Risk management tools

Source: Adapted from The Energy and Resources Institute et.al. 2014. *Low Carbon Development in China and India: Issues and Strategies (Advance Publication)*

Green credit for fixed asset loans is becoming more common in China. Carbon asset pledge credit services, whereby mortgages or short-term loans are provided by commercial banks based on carbon assets registered with the CDM, are less common. International carbon factoring services are another CDM project related financing scheme, whereby an enterprise transfers receivables in the form of a credit sale to a bank, and the bank provide comprehensive financial services (including financing, receivables management, receivables collection, and credit risk guarantees) for the enterprise. Bonds

are currently not a feasible financial tool for local governments in China, and venture capital for clean energy companies is still limited. However, insurance and reinsurance for clean energy technologies are becoming more common.³⁸

5.3. Innovative technological solutions

Cities offer ample opportunities to implement low carbon solutions. Many cities are already implementing strategies that are helping them to increase their use of renewable energy, become more energy efficient, and increase mobility choices while decreasing emissions from transportation. While each city needs to examine its particular circumstances, ensuring that its orientation is toward the efficient use of resources will help it choose better technologies and better options for city development. Many of the most effective interventions in urban areas offer multiple benefits- social and economic as well as environmental. The following table highlights a number of proven green strategies successfully implemented in many cities around the world.

Table 6: Technical Interventions by Municipalities

Overview of City Strategies				
	Sector			
<i>Case Study City</i>	<i>Energy</i>	<i>Urban Transportation</i>	<i>Land Use Planning</i>	<i>Green Building</i>
Hong Kong	<ul style="list-style-type: none"> • Renewable fuel mix • Offshore wind • Waste-to-energy 	<ul style="list-style-type: none"> • High-speed and light rail, rapid bus, and ferry • Planning standards for pedestrian movement 	<ul style="list-style-type: none"> • Planning to minimize need to travel: development around railways and balanced uses • Conservation zones 	<ul style="list-style-type: none"> • Mandatory commercial building energy efficiency standards • District cooling or water-cooled air
Adelaide	<ul style="list-style-type: none"> • Green Power Program • Smart grid 	<ul style="list-style-type: none"> • Massive investment for dedicated rail/bus corridors • Bicycle Action Plan • Integrated Movement Strategy 	<ul style="list-style-type: none"> • High-density mixed-use development • <i>Guide to Mixed Use Development</i> • City Parklands Trail 	<ul style="list-style-type: none"> • Rebates for installation of rainwater tanks, solar panels and hot water systems • Retrofitting existing buildings
Tokyo	<ul style="list-style-type: none"> • Green Power Purchasing Program and national network • Cap-and-trade 	<ul style="list-style-type: none"> • First-class transit system • Park-and-ride • Bike sharing 	<ul style="list-style-type: none"> • Transit-oriented regional structure • Pedestrian-oriented development 	<ul style="list-style-type: none"> • Campaign for Elimination of Incandescent Lamps • Facilitate collaboration

³⁸ For more information, see The Energy and Resources Institute et.al. op.cit. p.112-132.

	<ul style="list-style-type: none"> for large businesses Bond incentives for conservation 		<ul style="list-style-type: none"> Historical gardens 	<ul style="list-style-type: none"> among solar equipment manufacturers and energy suppliers
Seoul	<ul style="list-style-type: none"> Fuel cell technology Smart Grid Initiative Institute for Solar Energy Systems 	<ul style="list-style-type: none"> No-Drive Day Campaign Flat rate for transit trips and transfers Dedicated bus lanes 	<ul style="list-style-type: none"> National green building standards consider TOD Green Design Project: “city within a park” Green belt 	<ul style="list-style-type: none"> Green rooftop projects C40 Building Retrofit Project Tax incentives for efficient buildings
Yokohama	<ul style="list-style-type: none"> Green Power Project – residential cost assistance Biodiesel fuel for public facilities 	<ul style="list-style-type: none"> Mobility Management Campaign Bike sharing 	<ul style="list-style-type: none"> Integration of land use and transportation Subsidy for inner-city development Greenery Tax 	<ul style="list-style-type: none"> HEMS combined with high-efficiency insulation for 4,000 existing homes and all new homes
Tianjin Yujiapu	<ul style="list-style-type: none"> Smart Energy Networks 	<ul style="list-style-type: none"> Bus rapid transit High-speed rail Underground pedestrian walkways 	<ul style="list-style-type: none"> High-density, mixed-use around Station Cores Land recycling 	<ul style="list-style-type: none"> Building lifecycle development Water and material reduction; operating

Adapted from: Alven H. Lam, Brianne M. Mullen, Sixth Urban Research and Knowledge Symposium 2012. *Comparative Analysis of Best Practices of Sustainable Communities: Asia Pacific Rim and United States*

5.4. International initiatives

Municipalities are becoming more and more adept at forging partnerships for effective action on climate change issues. These partnerships may be regional, national or international and may involve funding and/or capacity development and knowledge exchange.

5.4.1 Urban NAMA's

Nationally Appropriate Mitigation Actions, or NAMAs, are voluntary actions for reducing greenhouse gas emissions in developing countries organized under the auspices of the UNFCCC. They can be any policy, project or programme that results in measurable GHG reductions.³⁹ The first dedicated fund for NAMA implementation was launched in 2013, as was the NAMA Registry. 2013 saw an upsurge in NAMA projects registered to the database. Given the newness of the program, many projects are understandably still in the concept stage, but a few are moving to implementation. Energy and transportation had the highest share of projects, particularly noteworthy as these

³⁹ Daniela Carrington, *Nationally Appropriate Mitigation Actions*, PPT presentation, UNDP in Europe, 2012.

sectors tended to be underrepresented in the Clean Development Mechanism,⁴⁰ and particularly appropriate in the context of sustainable urbanization.

Guidance on NAMA design is available from the UNFCCC website and several international organizations have produced tools and methods to support cities in become less carbon intensive as compiled by UN Habitat in Annex 2 of the *Guidance for NAMA design*. The NAMA process is designed to be flexible so that NAMA projects can (and should) be developed within the context of national Low Emission Development Strategies and in line with local sustainable development goals.

Some donors have set up funds that specifically support NAMAs (e.g. the UK/German NAMA Facility). The Global Environment Facility has also announced support for NAMAs. The Green Climate Fund is expected to be a major source of climate financing and to receive its first capitalization in end-2014, including to support “readiness” activities in developing countries.

Urban NAMA could become a mechanism supporting Chinese cities to benefit from the international carbon finance, complementing other sources of domestic and possibly international funding, as well as contributing to realistic, integrated and holistic low emission development in cities and in China as a whole.

5.4.2 City networks, technical and capacity support

There are many city networks as well as civil society and international organizations that offer knowledge exchange, technical and capacity support to cities for implementing low carbon strategies. Universities, both abroad and in China, also collaborate with local governments to conduct research and provide training on a wide range of issues that affect urban sustainability. Appendix 7 lists several of the major international organizations working on climate change and cities.

City networks provide opportunities for cities to learn from one another (including learning from one another’s mistakes), to support local champions for more sustainable development, and to scale up best practices. Some of the most exciting and hopeful developments in climate change mitigation and adaptation are going on at the municipal level around the world. Networks enhance this work.

6. CONCLUSION AND RECOMMENDATIONS

These recommendations are based on a review of selected actions undertaken in China and other countries as documented above, as well as on the extensive experience of

⁴⁰ http://ccap.org/assets/Mitigation_Momentum_Annual_Status_Report_2013.pdf

UNDP/GEF, UN-Habitat, and UNEP/CSP in supporting countries, regions and local authorities with their transition to more sustainable, less carbon intensive economies.

The recommendations can be summarised in four words: Integration, innovation, iteration and capacity building. Integration of climate action across sectors and regions; technological innovation and alternative approaches to natural resource management and use; and capacity building of local authorities and the public alike are three of the key actions and policy orientations that need to be taken in an iterative manner to take China's laudable efforts to address climate change to the next level and make them cost and climate change efficient and effective.

Recommendation 1: Holistic, integrated, and coordinated low carbon, climate resilient strategies, approaches, and implementation plans are needed to address climate change, so that actions taken in one area or sector are not voided in terms of net carbon emissions gains by actions not taken in other areas. For example, if an action is taken to curb industrial CO₂e emissions but at the same time emissions from transport continue unabated, the net overall result might still be an increase in CO₂e concentrations and associated impacts. Mitigation and adaptation are two sides of the same coin and need to be addressed simultaneously, with an emphasis on co-benefits. Mixed use communities where residents can work, live and have access to services and recreation, or transit-oriented development that provides easy access to employment and services not only improve the liveability of a city, but are proving to have significant impacts on carbon and other pollution levels.

As the above summarised research points out, most of the action taken today by cities around the world is piece meal and ad hoc, addressing individual sectors of the economic and social fabric of a city in isolation. As laudable as these early efforts by cities are, in the long term they are not enough.

The need for integrated and holistic approaches to address climate change is well documented in the scientific literature but often not applied at the local, city, provincial and national levels. A holistic and integrated way for low-carbon urban development can be based on life-cycle thinking and establishing carbon foot-printing for the city. This approach will take into account GHG emissions (and other environmental impacts) throughout all stages including planning, development, infrastructure construction, use-phase of buildings and transport systems, demolition and end-of-life stages. Only by adopting life cycle approaches emissions along the whole life cycle can be reduced. It also helps avoiding the shifting of emissions from one location to another (e.g. relocation of emission sources from one city to another). Finally, life cycle approaches will be necessary for cities to establish accurate emission inventories, the basis for emission trading systems.

Recommendation 2. New technologies and new natural resource management approaches need to be developed and employed on a wide scale. Variations on- and deviations from- business as usual (BAU) are not enough to keep global temperatures from rising less than an average of 2 degree Celsius. Major changes in most economic production and consumption patterns are needed, complemented by attitude and perception changes by society. Indeed, even if all best available technology and resource management approaches are applied world- wide, build-up of CO₂e in the atmosphere over time would still be above concentrations that the international scientific community considers to be safe. Urban areas as centres of innovation need to conduct research and spearhead the implementation of new urban development approaches, applying new and innovative technologies to address sets of interconnected environmental, social and economic problems.

The 2014 Interim Report of the Pathways to deep decarbonisation project in which China participated, states: “The latest scientific research indicates that keeping below the 2°C limit is challenging but feasible. Global studies—including the scenarios reviewed by the IPCC AR5 WG3, the IEA World Energy Outlook (WEO) and Energy Technology Perspectives (ETP) reports, and the Global Energy Assessment (GEA) led by the Institute of Applied Systems Analysis (IIASA)—show that reducing global GHG emissions to a level consistent with the 2°C limit is still within reach.”⁴¹ However the report also notes that very few countries, let alone cities, have looked seriously at the operational implications of staying within the 2 C limit. Most 2020 emission reduction targets are framed as deviations from the Business as Usual trends, reducing the carbon intensity of GDP. Collectively these efforts will be insufficient to put the countries on a trajectory consistent with the 2 C limit global target. 2 degrees Celsius will require major transformations of energy and production systems, industry, agriculture, land use, consumption patterns and other economic development activities.⁴²

The scientific evidence is clear: addressing climate change requires profound changes in the prevailing socio-economic development patterns. Many of the technologies needed to forward the transformation of our economic systems are available (low hanging fruit, win-win solutions). Many others are not as yet ready for large scale deployment. Considerable further research is needed to devise low carbon climate resilient development patterns that can conform to the global target. This includes research on changing consumption patterns of urban middle class consumers and development of approaches to promote sustainable green lifestyles. It will also require long term international cooperation, financing and trust.

Recommendation 3: An adaptive and iterative approach to addressing climate change in cities is needed.

⁴¹ Sustainable Development Solutions Network. *Pathways to Deep Decarbonization*. September, 2014. p.ix.

⁴² For more documentation see

http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/climate_strategy/green_lecrds_guidancemanualsandtoolkits/

The magnitude of the decarbonisation challenge is such that there is no quick or easy fix. Addressing climate change in cities is not about modest and incremental changes or small deviations from BAU. It requires major changes to urban economic and social systems, and production and consumption patterns, over long periods of time and in an adaptive and iterative manner. Policy and investment decisions, and management approaches need to be continuously revised and adapted to take the latest scientific evidence and knowledge into consideration; new and emerging technologies and natural resource management practices need to be constantly applied. The impact of action on existing infrastructure stock and vested capital need to be assessed, as does the impact of possible stranded assets. City authorities need to continually keep the need for these transformative changes in mind, for example when they plan city expansion, decide on investments, particularly infrastructure investment, and issue new regulations and legislation. The city administrative and institutional set-up must reflect this integrated approach. Cost benefit analysis of alternative technological and management options, as well as their financial, policy, and social implications, needs to be carefully considered. Changes in consumer behaviour must be promoted and technological innovation supported. For instance, product-service systems offer potentials to reduce the impacts of consumption while offering consumers the same benefits of conventional approaches to consumption. Decisions made today for example regarding infrastructure and power generation have a long term impact on GHG emissions which must be mapped out and understood quantitatively. This integrated holistic approach is further detailed in the UNDP Energy and Environment Group's approach to low carbon climate resilient development.⁴³

Given the massive changes in the socio-economic fabric that addressing climate change requires, as well as the substantive redirection of financial flows towards low carbon, climate resilient investments, wise and enlighten local and national governments will take other social and economic issues into consideration at the same time. These include addressing poverty, rural/ urban integration, and greening the economy. Vertical integration of plans and action from the local level to the national level is needed. The city networks referred to in section 5.4.2, as well as, for example, the deep decarbonization project mentioned above, can be tools to help this integration and stimulate local and national discussion while at the same time increase learning from other countries and lessons learned from implementation in many cities around the world.

Though seemingly overly complex and overwhelming, addressing climate change in an integrated, holistic and coordinated way, from the local to the national level, is feasible and makes economic sense. Investments now in terms of time and money will avoid much more expensive investments in the future and reduce the costs of climate change

⁴³ For more details, see UNDP Energy and Environment Low-emission and Climate-resilient Development Strategies Toolkits and Guidebooks http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/focus_areas/climate_strategy/green_lecrds_guidancemanualsandtoolkits/

disasters and impacts. An adaptive and iterative approach is the only way forward, starting with the large scale introduction of win-win solutions, for example, energy efficiency and conservation, low carbon electricity and fuel switching. Investments in developing new technologies and changing consumption patterns now will pay off in the future.

Recommendation 4: A different type of urbanization to address the related current issues of sprawl, congestion and segregation in Chinese cities is needed.⁴⁴

An approach that promotes compact, integrated and connected cities will not only generate emission reductions but will yield significant socio-economic co-benefits. This can be achieved through more efficient use of urban land at different scales, from the planning of metropolitan regions down to the design of new neighbourhoods. This should be combined with more flexible zoning and mixed land use and supported by transit-oriented urban development incentives. Such measures will reduce the cost and resource intensity of urban infrastructure, enhance agglomeration benefits and encourage social integration.⁴⁵

As the Chinese government already has stated the goal of promoting “people-centred development” as an important element for future development, urbanisation is an area where people-centred development can be implemented. This would include providing space for community-based innovation for urbanization, such as “living labs” initiatives which actively involve citizens in co-creation processes.

Recommendation 5: The capacity of local governments to address climate change in a holistic, integrated and transformative manner needs to be greatly strengthened.

Local government capacity building is a critical piece in achieving low carbon development. National level plans and policies are generally of very high quality; however, if they are not implemented, or implementing improperly, China will not be able to achieve its sustainable urbanization goals. Local governments need technical support and research, but also need the ability to approach urban development in an integrated manner and develop the collaborative relationships with many stakeholders to be able to implement climate change mitigation and adaptation strategies. Many reviews of infrastructure lending by the World Bank or the regional development banks frequently raise the issue of the need to more capacity building, institution building and a more integrated approach.⁴⁶

⁴⁴ Based on discussions with UN Habitat staff member.

⁴⁵ For a detailed overview, see United Nations Human Settlement Programme, 2013. *Urban Planning for City Leaders*. 188 pp, Nairobi; Global Commission on the Economy and Climate. *The New Climate Economy, Better Growth Better Climate*, 2014. <http://newclimateeconomy.report/>

⁴⁶ For example, see

https://www.climateinvestmentfunds.org/cif/sites/climateinvestmentfunds.org/files/Ukraine%20UIP2_CT_F_final.pdf

By taking an integrated approach to policy and implementation, local governments are better able to address emerging issues in a complex environment. Better understanding of cities as systems helps local officials to see the interrelated consequences of decisions. There are a number of frameworks that are used around the world by municipalities working to achieve greater sustainability that invariably promote an integrated approach to city development as it is only through such a system approach that long term gains will materialize and more sustainable cities will see the light of the day.

UNDP China's most recent National Human Development Report also argues for the need for improving incentives and performance monitoring for local government officials in order to improve governance structures that then facilitate implementation of low carbon and other sustainable urbanization strategies and plans.⁴⁷

Recommendation 6: Re-evaluate financing mechanisms for local government investment in green infrastructure & greening municipal government procurement

Current structures for city financing are out of date and need to be re-evaluated at all levels of government. Local governments are too dependent on land sales for financing expenditures which encourages sprawl. Other disincentives to low-carbon choices need to be examined and discontinued- for example, encouraging car use and destroying bicycle infrastructure as car use is encouraged to support the automobile industry. Many cities around the world are using creative approaches to incentivize low-carbon development which could be applied in China.

Local government investment mechanisms for green infrastructure are closely related to government procurement systems and practices. There is huge potential for local governments to shift local municipal government spending towards green. Significant energy savings can be achieved through shifting government procurement in the area of energy saving office equipment.

Recommendation 7: Engage with national and international networks

Networks can support local governments to build capacity and learn from best practices, and in some cases, obtain financing. Chinese cities, especially smaller ones, are less engaged in international networks than many cities around the world and should be supported and encouraged to take advantage of the tremendous upsurge in city-to-city networking currently underway globally. China can learn from what is happening in other countries, but China can also inform other countries. Everywhere ad hoc approaches are taken in cities that will not deliver the necessary results. China should become an active (and leading) partner in the major international programmes and networks that address urban climate change (and world climate change for that matter).

⁴⁷ UNDP, 2013. op.cit. p. 103.

APPENDICES

Appendix 1: Climate Change in Chinese Cities

Table 1: Top 20 cities vulnerable to sea level rise

City Ranking by Relative Risk (as a percentage of city GDP) 2005		
Ranking	City	Average Annual Loss, with protection (% of GDP)
1	Guangzhou, China	1.32%
2	New Orleans, U.S.A.	1.21%
3	Guayaquil, Ecuador	.95%
4	Ho Chi Minh City, Vietnam	.74%
5	Abidjan, Ivory Coast	.72%
6	Zhanjiang, China	.50%
7	Mumbai, India	.47%
8	Khulna, Bangladesh	.43
9	Palembang, Indonesia	.39
10	Shenzhen, China	.38
11	Hai Phong, Vietnam	.37
12	N'ampo, North Korea	.31
13	Miami, U.S.A.	.30
14	Kochi, India	.29
15	Tampa-St. Petersburg, U.S.A.	.26
16	Nagoya, Japan	.26
17	Surat, India	.25
18	Tianjin, China	.24
19	Grande_Vitoria, Brazil	.23
20	Xiamen, China	.22

Adapted from: Stephane Hallegatte, et. al. *Future flood losses in major coastal cities*, Nature Climate Change 3, August, 2013, p. 802-806

Appendix 2: China's Renewable Energy Capacity

Table 2: China's renewable, nuclear and natural gas capacity 2010

Type	Amount
Hydropower	210 GW (annual power generation at 650 billion kWh)
wind power	40 GW (including off-grid units);
Photovoltaic	800 MW
solar water heaters	168 million m ²
solar thermal energy	1.48 billion m ² (floor area using)
shallow geothermal energy	227 million m ² (floorage using)
biomass power-generation	5.5 GW

nuclear power	10.82 GW
natural gas	94.85 billion m3
coal-bed methane	6 billion m3 extracted, 3.6 billion used

Source: *Second National Communication on Climate Change of the People's Republic of China*⁴⁸

Appendix 3: CCICED Studies

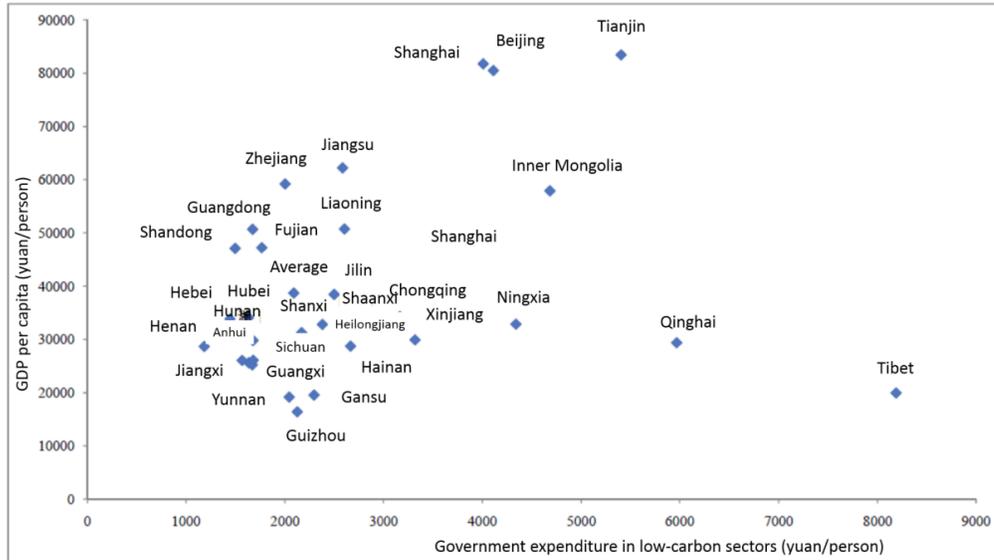
Recent past and ongoing CCICED policy research projects relevant to urbanization and climate change include:

- (1) Good City Models of Urbanization Under the Concept of Ecological Civilization (2014)
- (2) Environmental Protection and Social Development (2012-2013)
- (3) Sustainable Consumption and Green Development (2012-2013)
- (4) Policy on Promoting Social Media and Public Participation in China's Green Development
- (5) Corporate Social Responsibility in Green Development
- (6) Promoting Urban Green Commuting
- (7) Policy Mechanism for Meeting the "12th Five-Year Plan" Environment and Development Objectives (2011-2012)
- (8) Strategy and Policy on Environment and Development of West China (2011-2012)
- (9) Environmental Strategy and counter-measure for East China in Transformation (2012)
- (10) Research on Regional Air Quality Integrated Control System (2012)
- (11) China's Marine Environment Management Mechanism – based on Case of the Bohai Oil Spill (2012)

Appendix 4: GDP and Low-carbon Expenditure

Graph 2: Comparison of Per Capita GDP and Per Capita Low-carbon Expenditure in China in 2011 (Unit: yuan/person)

⁴⁸ <http://www.ccchina.gov.cn/archiver/ccchinaen/UpFile/Files/Default/20130218145208096785.pdf>



Source: Adapted from The Energy and Resources Institute et.al. 2014. *Low Carbon Development in China and India: Issues and Strategies (Advance Publication)*

Appendix 5: Municipal Sustainability Policies

Type of measure	Characteristics	Cities
Planning		
Comprehensive planning/Master planning/Community Planning (different names in different countries; note: Master Plans in many jurisdictions are limited to land use)	<ul style="list-style-type: none"> • A type of strategic planning • Sets high level goals for community development • Sets public policy for land use, transportation, utilities, green space, housing, etc. • Time horizon generally longer term • Understands linkages between urban systems therefore encourages more efficient use of resources • Many comprehensive plans now explicitly outline sustainability/emission reduction goals • May not include sustainability goals • Can be used to impose higher level government priorities with no respect for local conditions 	Sustainability-oriented comprehensive planning: Vancouver (almost all Canadian municipalities incorporate sustainability goals into their Official Community Plans); Singapore (land use only)
Integrated land-use and transportation planning (especially with a public transportation component)	<ul style="list-style-type: none"> • Land development is directed to transportation nodes and corridors • Usually seen as a way to encourage mixed-use, compact, transit oriented communities • One of the most effective policy intervention for GHG reduction at the city level if done correctly 	Calgary Adelaide (part of the larger South Australia integrated plan)
Participatory planning/budgeting (not necessarily sustainability oriented, but a key part of almost	<ul style="list-style-type: none"> • Engage citizens in setting policy priorities • Ensures public support for planning/budgeting goals • Effective education and governance tool 	Porto Alegre Durban Vienna (gender mainstreaming)

all sustainability oriented planning)		
Sustainability Plan/Energy Management Plan/Greenhouse Gas Mitigation and/or Adaption Plan	<ul style="list-style-type: none"> ● Plans specifically oriented towards sustainability or emission reduction goals ● Prioritize specific energy efficiency/emission reduction goals ● Can lose priority for implementation if not linked strongly with other municipal plans 	Muangklang (low carbon city plan) New York (Energy Efficiency and GHG Reduction Plan) San Jose (Strategic Energy Plan)
Mixed-use zoning	<ul style="list-style-type: none"> ● Sets standards for combining residential, commercial, cultural, institutional, and, where appropriate industrial uses ● Generally linked to increased density and more compact development ● Residents can walk or bike to many amenities ● Easier to link to public transportation 	Freiburg
Urban growth boundaries/green belts/agricultural land reserves	<ul style="list-style-type: none"> ● Guides zoning decisions to limit urban development to a set area ● Establishes protected undeveloped areas, green space or agricultural land ● Prevents sprawl ● Protects agricultural or undeveloped land ● Requires municipalities to think more carefully about appropriate development 	Urban growth boundary: Portland, Albanian municipalities Green belt: Hong Kong, Niagara Peninsula, London ALR: British Columbia
Urban greening/agriculture policies	<ul style="list-style-type: none"> ● Policies that allow and support the conversion of waste land (e.g. infrastructure right-of-ways, vacant lots) into community or market food gardens ● Zoning and building codes to allow urban greenhouses and rooftop gardens ● Protects and increases green space ● Reduces ‘food miles’ ● Improves food security ● Can contribute to waste diversion if linked with composting initiatives 	Community gardens: Dar es Salaam Havana Vertical farms, green roofs: Singapore Vancouver
Buildings		
Green Building Codes	<ul style="list-style-type: none"> ● Requires all new buildings to incorporate energy efficiency and water saving measures in design and construction ● Often includes requirements for reduction of construction waste and use of sustainable or low-pollution building materials ● May include renewable energy requirements (e.g. for solar hot water-Sao Paulo) or requirements for piping standards so that the building can be retrofitted for solar panels/other renewable energy options 	California State code (most municipalities have their own codes) Vancouver Sao Paulo
Sustainability checklists	<ul style="list-style-type: none"> ● Expediting approval processes for developments that meet city sustainability requirements or 	Port Coquitlam Sustainability Checklist

	guidelines	for rezoning
Density bonusing	<ul style="list-style-type: none"> ● Allowing developers to add density in return for energy efficiency or community amenities 	Toronto Vancouver
Transportation		
Public transportation planning and prioritization	<ul style="list-style-type: none"> ● Transportation planning is oriented towards public and non-motor transportation ● Multi-modal transportation options form part of an integrated mobility plan ● Congestion fees for private vehicles 	Bogota Mexico City Curitiba Copenhagen Singapore London
Waste		
Zero waste strategies/waste diversion	<ul style="list-style-type: none"> ● Strategies or plans that support recycling, composting, etc. ● Education campaigns for waste reduction ● Fee structures that reduce waste (e.g. fees for garbage removal but not for recycling) ● Can include pressuring suppliers to decrease unnecessary packaging 	Honolulu Halifax Hamburg
Municipal Finance		
Triple bottom line/alternate accounting/ sustainable procurement policies	<ul style="list-style-type: none"> ● Evaluates all budget expenditures on the basis of meeting social, environmental and economic targets instead of on a more traditional cost/benefit analysis 	London Many local governments in the EU and Canada

*Some public policy measures (e.g. encouraging green buildings, public transportation) are obviously linked to energy efficiency and therefore climate change mitigation efforts. Others (e.g. master planning or participatory planning) may not be directly linked, but have formed an important part of achieving other goals that result in emissions reductions. Results will of course vary from city to city and project to project.

Appendix 6: Financing Options

Table 10 -- Major Foreign and Carbon Financial Products

Regions	Name	Carbon Finance
Europe	European Climate Exchange (ECX)	Future option products of EUA, ERU and CER forward
	European Energy Exchange (EEX)	Electric available goods, Electricity, EUAs
	Nord Pool (NP)	Electricity, EUA, CER
	BlueNext Exchange	Available products and derivatives from EUA and CER
	Climex Exchange	EUAs, CERs, VERs, ERUs and AAUs
America	Green Exchange	EUAs, CERs, RGGI, SO2 and NOx quota and California Carbon Emission Quota CCAS, in

		addition there is the VER/VCU, RECs
	Chicago Climate Exchange (CCX)	six kinds of green houses offset project trade credit of North America Brazil
	Chicago Climate Futures Exchange (CCFE)	Future Contract of standard and settle accounts of discarded discharge quota and other environmental products
Australia and Asia	Australian Climate Exchange (ACX)	CERs, VERs, RECs
	Australian Securities Exchange (ASX)	RECs
	Australian Financial and Energy Exchange (FEX)	environment etc. exchange products and Over-the-Counter services
	Singapore Mercantile Exchange (SMX)	
	Singapore Asia Carbon Exchange (ACX-change)	Long Term contract of carbon credit future goods and share options or the already signed and issued CERs or VERs auction
	Multi Commodity Exchange of India(MCX)	Two carbon Trade credit carbon product contracts— — CERs and CFIs
	National Mutli Commodity Exchange of India Ltd.	CERs

Source: The Energy and Resources Institute, 2014. *Low Carbon Development in China and India: Issues and Strategies* (Advance Publication)

Appendix 7: Networks Supporting Cities

a) ICLEI- Local Governments for Sustainability

<http://www.iclei.org/>

ICLEI is an association of cities and local governments dedicated to sustainable development. Membership includes 12 mega-cities, 100 super-cities and urban regions, 450 large cities as well as 450 medium-sized cities and towns in 86 countries.

ICLEI provides a wide range of services to cities, including advocacy, tools, research, capacity building, networks and events such as the ICLEI World Congress or the Resilient Cities Congress. Some examples of programs and initiatives directly related to climate change include:

- Green Climate Cities Program- building on their earlier extremely successful Cities for Climate Protection program, this program provides a methodology, tools and technical support for cities to reduce their carbon emissions.
- carbonn Cities Climate Registry (cCCR)- the largest global database of local climate actions
- Urban LEEDS (low emission development strategies)- a partnership with UNHABITAT to provide tools (including emissions tracking software), methodologies and capacity building to developing country cities

b) C40 Cities Climate Leadership Group

<http://www.c40.org/>

C40 is a global network of cities dedicated to taking action to reduce greenhouse gas emissions. The network has three membership categories: Megacity (a population of 3 million or more, and/or a metropolitan area of 10 million or more); innovator city (smaller cities that are recognized leaders in climate and sustainability work); observer city (new members or members who for regulatory reasons cannot become full members).

C40 provides support to cities through:

- **Direct Assistance:** Regional Directors are provided by C40 to qualifying cities to provide on the ground assistance in climate protection policy and initiatives. C40 links members with its partner organizations to provide technical assistance for policies, programs and projects
- **Peer-to-peer Exchange:** C40 links network cities to share ideas and develop solutions through their biennial summit and topic specific workshops. It also has sub-networks currently focused on seven issue areas: Adaption and water; Energy; Finance and economic development; Measurement and Planning; Solid Waste Management; Sustainable Communities; Transportation
- **Research and Communication:** C40 conducts research using data from across the network, identifies successes, challenges and measures progress. Staff also publicize achievements of member cities.

c) UCLG

<http://www.uclg.org/>

United Cities and Local Governments (UCLG) is the largest local government organization in the world. Members include individual cities and national associations of local governments. 1000 cities across 95 countries are direct members of UCLG and 112 Local Government Associations (LGAs) are members, representing almost every existing LGA in the world. It has 7 regional offices and a dedicated section for larger metropolitan areas, Metropolis (see below). It has standing committees and working groups in a number of areas and identifies climate change and sustainable development as key issues. It engages in advocacy, research and networking. In particular it advocates for national governments and international organizations to recognize the role that local governments have in a wide range of urban issues.

d) Metropolis

<http://www.metropolis.org/>

Metropolis, or the World Association of the Major Metropolises, provides an international forum for issues of concern to major metropolitan areas. It has 130 members from across the world, and also operates the metropolitan section of UCLG. Although it does not deal exclusively with climate change issues, it has an initiative dedicated specifically to climate change mitigation and adaptation and hosts workshops and training sessions on climate-related issues, as well as other sustainability-related issues that can impact climate change.

Metropolis provides support to cities through:

- Triennial congresses
- Representing metropolitan issues at international organizations (especially the UN, but also through UCLG, the World Bank, US Conference of Mayors, ICLEI, etc.)
- Technical assistance supported by the Global Fund for Cities Development
- Training through the Metropolis International Training Institute located in Seoul and 4 regional offices in Cairo, Mashhad, Mexico City and Paris (Île-de-France) generally on a cost-share basis (e.g. participants pay travel costs, the Institute provides the training free of charge)
- Forum of Metropolitan Mayors
- Metropolis International Women's Networks- a peer network for women who hold political or other leadership positions in member cities
- Metropolis Awards- given out every 3 years in recognition of members' projects that have improved citizens' lives
- Publications and communications

e) Cities Alliance

<http://www.citiesalliance.org/node/3750>

Cities Alliance is a global partnership made up of local and national governments, NGOs, and multilateral organizations dedicated to urban poverty reduction and sustainable city development. It supports policy development, planning, capacity building and citizen engagement.

Cities Alliance provides support to cities through:

- The Catalytic Fund- project funding awarded through a call for proposals organized around specific themes
- Communications and advocacy- at major international meetings. As well, the Policy Advisory Forum held annually is a platform for knowledge sharing and discussion.
- Country Programmes- develop a framework for cooperation between national and local governments and the urban poor, and coordinate funding to fill action or knowledge gaps
- Knowledge and learning- share experience between members, develop guidelines and toolkits, communities of practice, peer-to-peer learning, etc.

f) The World Bank Urban Development

<http://www.worldbank.org/en/topic/urbandevelopment/overview>

The World Bank's urban agenda focuses on providing technical assistance, research and financing in a number of areas including low-carbon growth and management of climate risk. Other parts of the Bank's urban agenda such as good governance, slum upgrading, job creation, etc. may also impact climate issues and low-carbon sustainability is a consideration in the evaluation of all investment. Some of the programs most directly related to climate include:

- Low-carbon Livable Cities Initiative- provides tools for GHG inventories, evaluation of emissions reduction potential of different investments, etc. and develops new financial instruments for low-carbon investment in cities.
- Urbanization Knowledge Platform- a network of over 70 partner organizations providing a platform to share best practices
- Partnership for Smart and Sustainable Cities- knowledge-sharing platform and facilitator of cross-sectoral collaboration
- Eco²Cities- an initiative promoting the interdependence between ecological and economic sustainability
- Global initiative on solid waste management- includes tackling short-lived climate pollutants

g) Asian Development Bank

<http://www.adb.org/themes/urban-development/overview>

Urban Development in one of the ADB's thematic areas. Climate change mitigation and adaptation is part of its integrated approach to cities. ADB's Urban Operations Plan

identifies green, inclusive and competitive cities as priorities. Although ADB's lending for urban projects has clustered around water and wastewater projects to date, the Bank also identifies city cluster economic development, urban transportation, waste management, municipal finance, and urban renewal and slum rehabilitation as priority areas. The Clean Energy Financing Partnership Facility funds clean energy technology projects including projects that address policy, regulatory and institutional reforms to encourage clean energy development. In addition, ADB hosts the Urban Community of Practice to support knowledge exchange.

Many environmental NGOs such as the World Resources Institute, Carbon Forum, the National Resources Defence Council, the Institute for Sustainable Communities, Clean Air Asia, etc. all operate in China and frequently have programs and networks that cities can engage with on energy, sustainable development, pollution control etc.

h) The United Nations

UN Habitat is the UN agency mandated to foster sustainable urbanization. However, as urbanization and climate change have both become cross-cutting themes, the work of numerous agencies touches on these issues. **UN Habitat's Cities and Climate Change Initiative** enhances capacity of local governments in developing countries to address adaptation and mitigation at the local level. UNEP, UN Habitat, Cities Alliance, and the World Bank have collaborated on the Knowledge Centre on Cities and Climate Change (K4C). UNDP works with national, regional, and local planning bodies to help them respond effectively to climate change and promote low-emission, climate-resilient development. UNDP provides support in the following areas: Integrated Policy and Planning; Formulating, Financing and implementing Climate-resilient Projects and Programmes; and Knowledge Management and Methodology Support. Examples of projects include disaster risk preparedness training in Bangladesh, new legislation and industrial production of CFC-free appliances in Brazil, energy efficiency plans and audits for all towns and cities in Croatia, capacity building for the implementation of national carbon reduction targets at the provincial level in China, as well as the production of a National Human Development Report on Sustainable and Livable Cities in 2013.

Since almost all UN entities are engaged in climate change work, the UN launched an initiative in 2007 to better coordinate its response to climate change in order to avoid duplication and enhance effectiveness.