



Climate Resilient Cities

A Primer on Reducing Vulnerabilities to Disasters

Neeraj Prasad – Federica Raghieri – Fatima Shah
Zoe Trohanis – Earl Kessler – Ravi Sinha



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Foreword

Climate change is no longer a distant possibility but a current reality. Global temperatures have recorded unprecedented increases. The length and timing of seasons are changing. The frequency and severity of floods and cyclones accompanied by rising sea levels are increasing. In short, climate change has become one of the defining challenges for policymakers, industry, and civil society in this century, and it is a development, investment, economic, and social issue, which affects most sectors.

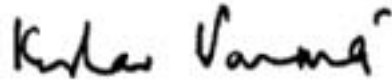
The East Asia Region will face the brunt of climate change impacts. A stark example of the future is the timing and intensity of the May 2008 Myanmar cyclone that left around 85,000 dead and many others missing, with millions homeless and food production severely affected. More recently, in August 2008, torrential rains in Laos led to flooding caused by the swelling of the Mekong River to its highest levels in 100 years, flash floods in Japan led to the evacuation of nearly half a million people, and Typhoon Nuri in the Philippines and floods in Vietnam and China led to deaths, displacement, and losses.

Loss from flooding and hurricanes is an all too frequent occurrence in many countries in the region, particularly in cities where people and assets are concentrated. Urban centers must be prepared with specialized tools to deal with climate change impacts and early warning systems. Moreover, given the potential devastation associated with future climate change-related disasters, it is vital to change the way we build and manage our cities, which account for 80 percent of greenhouse gas emissions today.¹

The 13th Conference of the Parties to the United Nations Framework Convention on Climate Change at Bali in December 2007 affirmed the increased willingness of city governments to take action in addressing climate impacts. The World Mayors' and Local Governments' Climate Protection Agreement lays out direct principles for adaptation and preparedness, in addition to concrete targets for mitigation. Similarly, the C40 Climate Leadership Group of large cities—including Bangkok, Hanoi, Hong Kong, Jakarta, Seoul, Shanghai, and Tokyo from East Asia—are cooperating to reduce greenhouse gas emissions.

Other natural disasters, beyond those that are climate induced, also add to the challenges facing East Asian cities. The *ring of fire*—composed of 75 percent of the world’s active and dormant volcanoes and located at the borders of major tectonic plates (prone to seismic activity)—follows along the eastern edge of Asia as well as Southeast Asia. China’s Sichuan earthquake in May 2008, the August 2008 earthquake in Indonesia, the tsunami that hit the Region in 2004, and the volcanic eruption from Mount Pinatubo in the Philippines in 1991 have all resulted in devastating economic damage and loss of lives.

Now is the time, therefore, for policymakers to take an integrated look at reducing vulnerabilities to climate change and other natural disasters in a comprehensive disaster management system.



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Executive Summary

Climate-Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters is prepared as a guide for local governments in the East Asia Region to better understand the concepts and consequences of climate change; how climate change consequences contribute to urban vulnerabilities; and what is being done by city governments in East Asia and around the world to actively engage in learning, capacity building, and capital investment programs for building sustainable, resilient communities. The Primer is applicable to a range of cities—from those starting to build awareness on climate change to those with climate change strategies and institutions already in place. An accompanying CD-ROM includes City Profiles to assist cities in understanding in more detail what other cities are doing today.

It is now undeniably evident that the global climate is changing as a result of human-induced greenhouse gas (GHG) emissions. Increased levels of heat trapped in the atmosphere have set off a process that is modifying weather patterns, which in turn affect temperatures, sea levels, and storm frequencies. This will impact cities and other urban areas, especially those in coastal zones. Asia already experiences the greatest number of flood events worldwide. Since the beginning of the 21st century, Asia has experienced more than 550 floods affecting over 850 million people.² Out of China's estimated urban population of 400 million, 130 million live in coastal cities that are vulnerable to sea-level rise.³ The high incidence of hydro-meteorological and other disasters affecting urban areas, particularly in vulnerable regions, is a challenge to local officials and their communities in being prepared and proactive in reducing their GHG emissions and in addressing increasingly frequent and extreme climate change events.

The world is at a unique moment in time. Three major movements are coming together: *urbanization, decentralization, and the rise of domestic capital markets.* The way cities are managed to deal with their growth and the increase of their vulnerabilities is very important in this context. Many East Asian cities are also experiencing very rapid urbanization and increasing decentralization. In 2004, for example, 40 percent of the world's cement and 27 percent of its steel went primarily to build China's cities.⁴ Most East Asian cities therefore have much greater responsibility for their increasing



populations to prepare them for the consequences of climate change, offer mitigation alternatives to current levels of GHG emissions, and devise the capital improvement projects necessary for resilient cities. The traditional sources of finance to cities from national government grants and allocations for budget support are insufficient and inefficient. Due to their increasing decentralization and increasing populations, most East Asian cities have much greater responsibility with limited traditional financial resources, but with unprecedented opportunity for domestic capital markets to make cities less dependent on national government for financial support. The access of funds through capital markets has begun to be recognized as an important adaptation initiative.

The most adverse impacts of climate change are likely to be in urban areas where people, resources, and infrastructure are concentrated. “In absolute numbers, Asia is the epicenter of the current urbanization surge. China will add at least 342 million people to its cities by 2030 ... and Indonesia, 80 million.”⁵ An estimated 46 million people living in cities are at risk yearly from flooding from storm surges in the East Asia Region.⁶ The responsibility of responding to climate change impacts and consequences will fall to city governments and their communities. Therefore a strong local commitment and organization is required to deal with behavior and technological change to reduce carbon emissions and the disasters that climate change consequences and regional threats represent. The response to climate change impacts are in their essence urban governance and management issues. Immediate action to reduce emissions will reduce future impacts but will not eliminate those already initiated.

Management of urban areas and their growth and spatial planning requires the consideration of disaster risk management and the climate change agenda as essential components of urban development.

There are important linkages between sustainable development, climate change impacts, and disaster risk management issues each city confronts. Dealing with climate change has initially focused on national or regional plans to reduce the contributions to global warming. But reducing GHG emissions is only one of the important efforts cities must understand. Disasters that result from and/or can be made worse by climate change can undermine decades of growth through a single catastrophic event. Management of urban areas and their growth and spatial planning requires the consideration of disaster risk management and the climate change agenda as essential components of urban development. Climate change will increase the frequency of disasters in cities. Effective disaster risk management is an important component of climate change adaptation.

Climate change will require concerted actions by local governments and their partners to manage a changing and more invasive environment. The need to promote changes in technologies, citizen participation, and urban growth patterns are equally important parts of the behavior of the urban populations that contribute to global warming and create vulnerabilities to disasters. Mainstreaming these issues into policy and practice leads to a holistic rather than sectoral engagement in climate change. Climate change and disaster risk management require concerted international cooperation and city partnerships. Indeed, this Primer reflects joint cooperation between three international agencies—the World Bank, the Global Facility for Disaster Reduction and Recovery, and the UN’s International Strategy for Disaster Reduction. This team hopes the Primer increases awareness, highlights successful practices that can be adapted to East Asian cities, and initiates a dialogue for action. The World Bank and its partners stand ready to assist client countries and their cities with technical and financial assistance as they move toward creating institutions, strategies, and infrastructure to combat climate change and natural disasters.



About the Primer

Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters is a tool for local governments to actively engage in the training, capacity building, and capital investment programs that are identified as priorities for building sustainable, resilient communities.

THE PRIMER APPROACH

The Primer uses a dual track approach to dealing with climate change impacts and disaster risk management issues. One track is to lower GHG emissions through *mitigation* (climate change management) programs of energy efficiency, the use of non-fossil fuels, controlling urban sprawl, improved public transport, recycling wastes and water reclamation. The other track addresses, through *adaptation* programs, the consequences of climate change and the increased frequency and intensity of extreme events and disasters that climate change is creating. These programs are intended to minimize the impact of conditions and disasters caused by climate change.

This Primer is a tool for initiating a dialogue with city officials in East Asia on how their cities can grow to become more resilient. The Primer has been prepared to inform local officials about climate change and to engage them in a city assessment and participatory approach for identifying and addressing key climate change impact issues and possible solutions. It recommends a supportive institutional and policy environment at the state and national levels to enable local adaptation.

The Primer is a motivating step intended to move communities through a process that leads to action and investments. Actions require human, technical, and financial resources for investing in adaptation, preparedness, and mitigation. The Primer introduces change through useful near-term to long-term activities. Initiating informed strategies with less complex near-term actions builds credibility for the local government and confidence to take on more complex mid- to long-term programs in response to climate change.



▲ *Aerial view of Banda Aceh prior to the 2004 tsunami.*

The Primer presents information in a style, tone, and depth that can be used by local governments to share with constituents. Awareness campaigns are important to explain the potential impacts and create a consensus on what may transpire, what and who might be affected, and what therefore can and needs to be done. The Primer emphasizes that the link between climate change and disaster risk management can make better use of citizen groups and volunteerism. This is happening in cities already. The concepts of climate change are simple if explained well, even though the science is complex. Therefore, it is recommended that local governments be organized to confront projected scenarios and create partnerships with centers of excellence to investigate climate change and its impacts to augment their capacity to prioritize and plan.

The Primer presents illustrative examples of mitigation and adaptation sound practices that have already been implemented in urban areas in East Asia and around the world. The leadership decisions are about establishing and exercising good local government resource management practices to create and sustain resilient communities through “no-regrets” policies. The strategies, plans, and activities presented as examples in Section 05 are the cornerstones for good urban management, including having the authority to raise the resources necessary to carry out city priorities financed through maturing domestic capital markets. Local government financial independence is an important key to its resilience.

The Primer emphasizes that the mutual ability of cities to learn is enhanced by their ability to exchange experiences. Local government associations are key tools that provide a platform for cities to come together and exchange their experiences. An important component of any association agenda would feature climate change impacts and disaster risk management as areas in need of and worthy of further attention.



THE PRIMER USER

The Primer is organized as a knowledge resource and process to engage government officials actively in educating themselves and their fellow citizens about the causes and effects resulting from climate change impacts and hazards. Once government officials have identified potential climate change impacts and hazard management issues that could directly affect their constituencies, they will be better prepared for structuring local government operations and developing and implementing actions that mitigate and adapt to the problems. The Primer can be used by any stakeholder—city leaders, civil society, city managers.

The Primer aims to help users answer these questions:

- How does climate change contribute to urban vulnerabilities?
- What are the threats of climate change and natural hazards to city activities and population?
- What is being done by city governments in East Asia and around the world to actively engage in learning, capacity building, and capital investment programs for building sustainable, resilient communities?

The information collection and city assessment activities in the Primer will help cities identify their vulnerabilities to potential climate change impacts and their level of preparedness to climate change and natural hazard risk management. A step-by-step city assessment will challenge policymakers to seriously think about their city resources and the potential effects of an unexpected disaster.

▲ *Aerial view of Banda Aceh destruction after the 2004 tsunami.*

THE PRIMER ORGANIZATION

Users can follow the order of the Primer’s contents or move about to focus on particular sections of interest or need. The Primer is divided into six sections followed by substantial supporting resource material:

Section 01/ Understanding the Impacts of Climate Change and Disaster Risk Management

is an introduction to climate change and disaster risk management, explained in context with the objectives of the Primer.

Section 02/ Explaining Climate Change Impacts and Disaster Risk Management. The concepts and consequences of climate change and disaster risk management are presented to illustrate the impact on cities and what cities can and are doing about it. The dual track approach is explained with examples of mitigation and adaptation programs associated with sea-level rise, temperature, precipitation, and extreme events. And the concept of resilience is discussed in understanding the vulnerability of urban areas.

Section 03/ Assessment Exercise: Discovery of a “Hot Spot.” Local governments and their stakeholders are presented with a tool for assessing vulnerabilities. Identifying unique built environment and social characteristics, organizational structure, and skills sets is the first step for a city to deal with the ever-increasing responsibilities of decentralization. For effective disaster risk management, the assessment looks at the city’s organizational structure and management tools for proactive and reactive responses to natural hazards. The assessment leads to determining priorities of actions to move a city away from becoming a “Hot Spot.” This totality of knowledge about the city’s vulnerabilities and strengths becomes a critical part of the city’s information base and planning process.

Section 04/ Information Exercise: Creating a City Information Base. This section takes the user through the steps of creating a City Information Base with all its resources consolidated into a single document, a Climate Change Impacts and Disaster Risk Management Workbook. The Workbook becomes a repository of information that is updated over time. The Workbook provides an opportunity for participation of many government departments, civil society, NGOs, support groups, private sector, and other stakeholders. The City Information Base is critical to developing, implementing, evaluating, and recording plans and programs to address current and future risks.

Section 05/ Sound Practice Examples of Adaptation and Mitigation presents a set of illustrative sound practice examples of adaptation and mitigation that are being implemented in select cities around the world. The sound practices are organized by area of concern to facilitate learning and discussion. Each city experience is fully discussed in the accompanying CD-ROM.

Section 06/ Conclusions gives a concluding wrap-up to the discussions in the Primer and promotes the startup and continuation of steps to becoming a resilient city. The Primer is just a tool that can be utilized to its fullest degree or in parts. After a city completes the recommended exercises, the Primer continues to offer many resources to help guide a city as it develops its strategy for resilience against the impacts of climate change and risks from disasters.

The concepts of climate change are simple if explained well, even though the science is complex.

The Primer Annexes and other supporting material provide more background resources to delve further into the issues and actions when answering the question “What else do I want and need to know?”

- ***Annex A: Worldwide Programs and Organizations on Climate Change and Hazards***
- ***Annex B: Sources of Technical and Financial Assistance***
- ***Annex C: Examples of Relevant World Bank Projects***
- ***Annex D: Resource Guide***
- ***City Profiles of Sound Practice*** (on accompanying CD-ROM) fully discusses the programs in selected cities that have demonstrated sound practice. The Profiles are a reference to actions identified and discussed in the “Hot Spot” assessments and in preparing the City Information Base. The City Profiles show the cross-sectoral nature of city initiatives to reduce emissions and adapt to changing conditions.



Acronyms and Abbreviations

3C	command, control, and communication
ABI	Association of British Insurers
ADPC	Asian Disaster Preparedness Centre
APEC	Asian-Pacific Economic Cooperation
ASMC	ASEAN Specialized Meteorological Centre
ASEAN	Association of Southeast Asian Nations
BCA	Building Construction Authority (Singapore)
BCPR	Bureau for Crisis Response and Recovery (UNDP)
C	Celsius
CCI	Clinton Climate Initiative
CCSFC	Central Committee for Storm and Flood Control (Hanoi, Vietnam)
CDM	Clean Development Mechanism (Kyoto Protocol)
CER	Certified Emission Reduction
CERT	Community Emergency Response Team (Albuquerque, USA)
CFCs	Chlorofluorocarbons
CH₄	Methane
CIG	Climate Impacts Group (University of Washington)
CIRCA	Center for Initiatives and Research on Climate Adaptation (Albay Province, Philippines)
CNCCP	China National Climate Change Program
CNG	Compressed natural gas
CO	Carbon monoxide
CO₂	Carbon dioxide
COP	Conference of the Parties (UNFCCC)
Dept.	Department
DFID	Department for International Development (U.K.)
DRI	Disaster Risk Index
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EAP	East Asia and the Pacific Region – World Bank
EASSD	East Asia and the Pacific Region Sustainable Development Department – World Bank
EASUR	East Asia and the Pacific Region, Urban, Water, and Disaster Management Sector Unit – World Bank

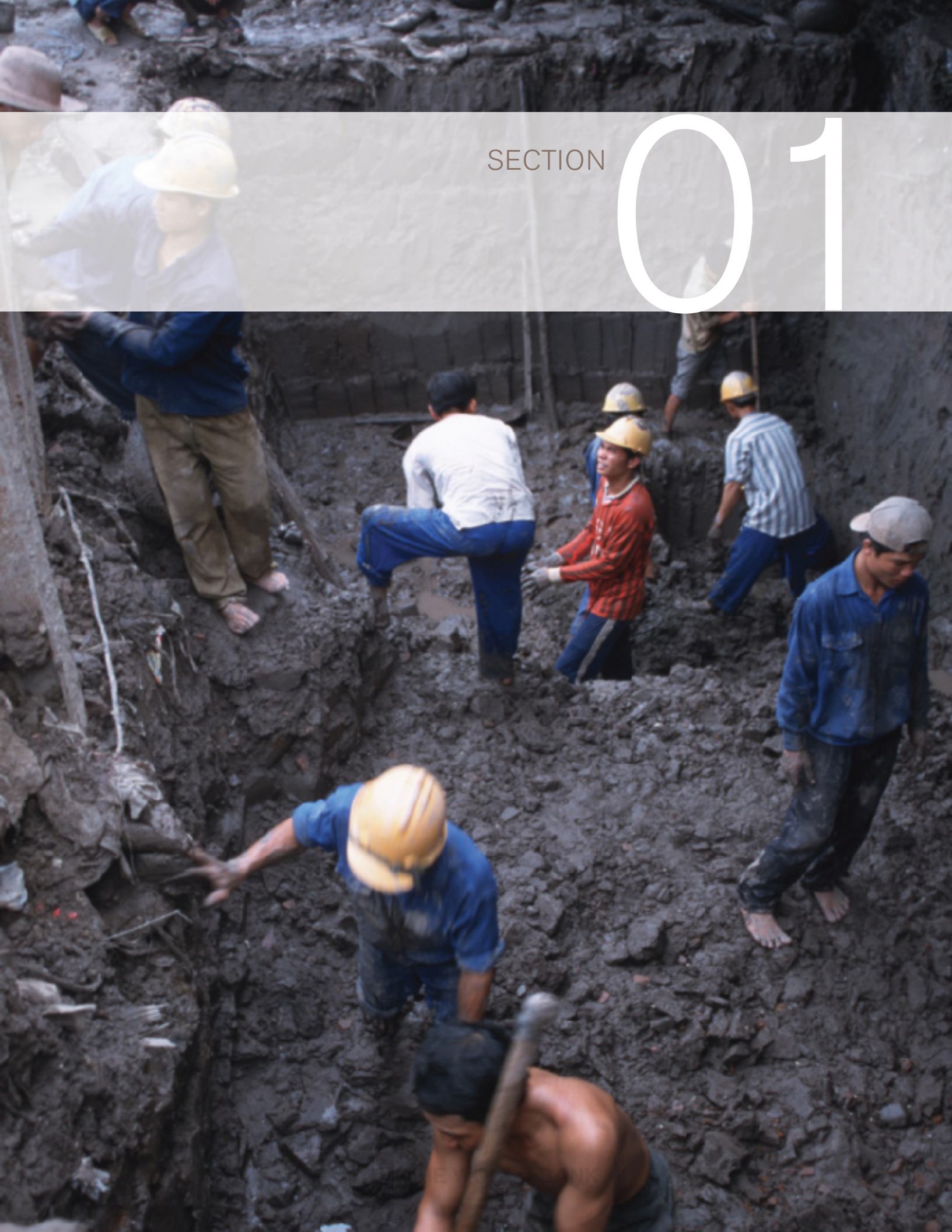
ECLAC	Economic Commission for Latin America and the Caribbean
EDB	Economic Development Board (Singapore)
EEA	European Environment Agency
EMI	Earthquakes and Megacities Initiative
EMS	Emergency Management Section of the Emergency Preparedness Bureau of the Seattle Police Department
ENSO	El Niño–Southern Oscillation
EU	European Union
F	Fahrenheit
FEMA	Federal Emergency Management Agency
GEF	Global Environment Facility
GDP	Gross Domestic Product
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIS	Geographical Information System
GRIP	Global Risk Identification Program (UNDP)
HDB	Housing Development Board (Singapore)
HDI	Human Development Index
IADB	Inter-American Development Bank
ICLEI	International Council for Local Environmental Initiatives
IEA	International Energy Agency
IFRC	International Federation of Red Cross and Red Crescent Societies
INCD	Intergovernmental Negotiating Committee
INEMAR	Inventario Emissioni in Aria (Milan, Italy)
IPCC	Intergovernmental Panel on Climate Change
JBIC	Japan Bank for International Cooperation
km²	square kilometer
kton	kiloton
LED	Light emitting diodes
LEZ	Low emission zone in cities (e.g., London, Milan)
LGA	Local Government Association
LNG	Liquefied natural gas
MCDCC	Makati City Disaster Coordination Council (Philippines)
MCEPC	Makati City Environmental Protection Council (Philippines)
MDG	Millennium Development Goal
MEWR	Ministry of Environment and Water Resources (Singapore)
MOSE	Modulo Sperimentale Elettromeccanico (Venice, Italy)
MoU	Memorandum of Understanding
N₂O	Nitrous oxide
NAPA	National Adaptation Programme of Action
NASA	National Aeronautics and Space Administration (USA)
NDMA	National Disaster Management Agency (Indonesia)
NDRC	National Development and Reform Commission (China)
NEA	National Environmental Agency (Singapore)



NGO	Nongovernmental organization
NH₃	Ammonia
NMVOG	Non-methane volatile organic compounds
NO_x	Nitrogen oxide
NRDC	National Resource Defense Council
NYC	New York City (USA)
NYCDEP	New York City Department of Environmental Protection (USA)
O&M	Operation and management
OECD	Organization for Economic Cooperation and Development
PACD	Plan of Action to Combat Desertification
PAP	People's Action Party (Singapore)
PCDD/Fs	Polychlorinated dibenzop-dioxins and dibenzofurans
PDR	People's Democratic Republic (Lao)
PM	Particulate matter
PM-2.5	Particles of 2.5 micrometers
PM-10	Particles of 10 micrometers
PUB	National Water Agency (Singapore)
RGGI	Regional Greenhouse Gas Initiative
R&D	Research and development
SCDF	Singapore Civil Defense Force
SDART	Seattle Disaster Aid and Response Teams
SEDAC	Socioeconomic Data and Applications Center
SGP	Singapore Green Plan
SINERGY	Singapore Initiative in New Energy Technologies
SLR	Sea-level rise
SO₂	Sulfur dioxide
TMG	Tokyo Metropolitan Government
TSP	Total Suspended Particles
UCLG	United Cities and Local Governments
UK	United Kingdom
UKCIP	United Kingdom Climate Impacts Program
UN	United Nations
UNISDR	United Nations International Strategy for Disaster Reduction
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCOD	United Nations Conference on Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USA	United States of America
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WRI	World Resources Institute

SECTION

01



Understanding the Impacts of Climate Change and Disaster Risk Management

This Primer is intended to be a tool and an applied knowledge resource for local governments and their stakeholders to address climate change impacts and disaster risk management issues in their cities. It is not an exhaustive compilation of thought and practice to “prove” that climate change is a threat, and does not present recipes for action. Rather, it offers principles and examples of sound practice that a city can adapt to its particular context.

A/ PRIMER OBJECTIVES

The Primer is an information resource for initiating a dialogue with local governments and their stakeholders. It emphasizes the importance of long-term communication and outreach and presents information that can be used by local governments in awareness campaigns and education programs at schools and community groups to explain potential impacts; who and what could be affected; and ultimately, what can and should be done.

The Primer offers illustrative examples of addressing disaster risk management and climate change as essential components of urban development and management. The Primer reinforces the idea that sustainable development in urban areas must include disaster risk reduction and climate change actions to reduce vulnerabilities. Figure 1.1 illustrates the linkages between disaster risk management, climate change, and development policy. Action on any front impacts the city on the other two fronts, and the impact may be either positive or negative. It therefore becomes imperative to ensure that the agenda on any one front does not increase the vulnerability on others. The climate change agenda needs to be viewed through the prism of the development agenda and should be embedded in the policies for disaster risk management. Forging links to citizen and volunteer groups is becoming an important part of disaster risk management in many cities and could play a role in a city’s mitigation and adaptation programs as well.

OBJECTIVES OF SECTION 01:

- Present objectives of the Primer.
- Discuss climate change and the need to address its impact.
- Highlight the linkage between climate change impact management, disaster risk management, and sustainable development in the context of urban management.

OUTCOMES OF SECTION 01:

- Gain an understanding of the reason climate change impacts may affect cities.
- Understand the linkages between climate change impacts and disaster risk management with sound urban planning.
- Use the information and resource material of the Primer for planning, outreach, and educational initiatives.



FIGURE 1.1 / Integrating climate change and disaster risk management into development policies

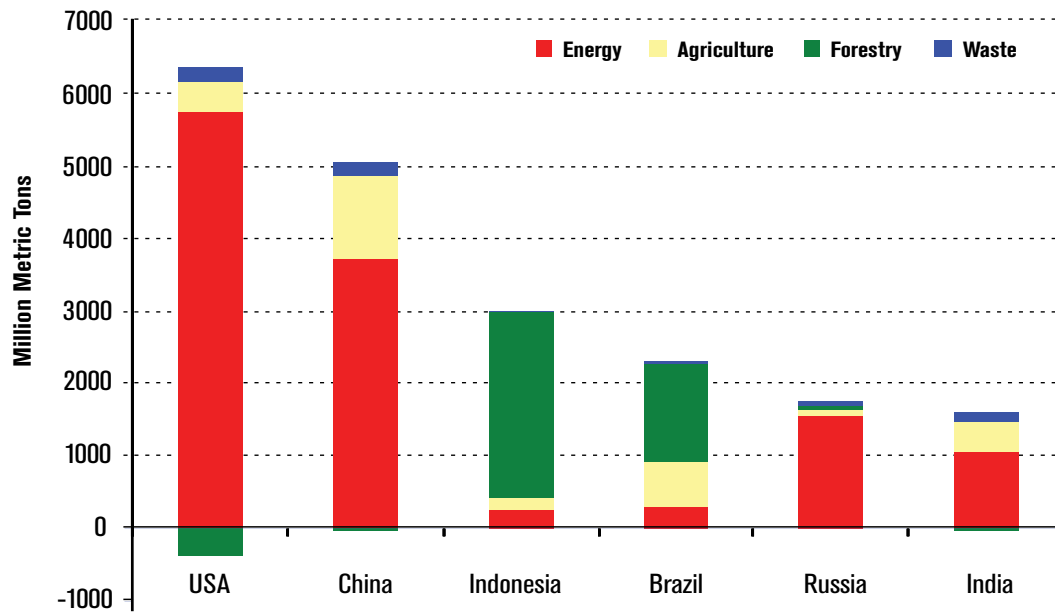
This Primer initiates a learning process that can be carried forward by local government on the issues of climate change, the potential consequences of climate change, and the critical relationship between current urban and financial trends with climate change, disaster risk management, and sustainable development.

B/ THE IMPERATIVES OF ACTION

East Asia is rapidly becoming a major contributor to GHG emissions.

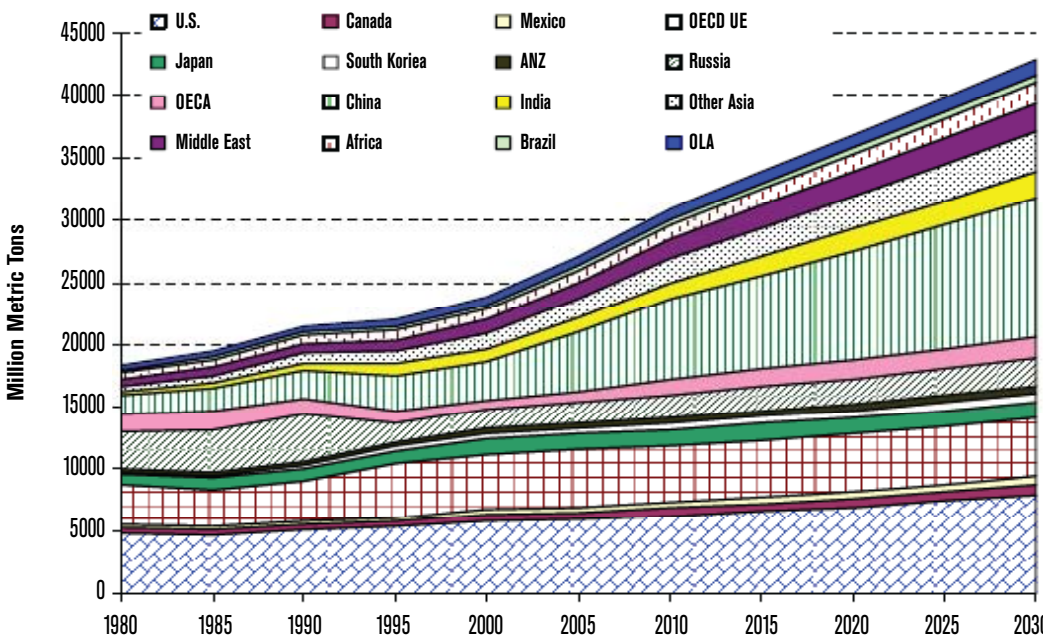
It is now undeniably evident that the global climate is changing, and that anthropogenic (human-induced) greenhouse gas (GHG) emissions are largely to blame. East Asia is rapidly becoming a major contributor to GHG emissions. In 2000, an estimated 18.7 percent of global emissions from fossil fuel combustion originated in the East Asia Region. By 2025, China alone is expected to increase its emissions by 118 percent.⁷ Projections are showing increases in emissions across Asia and other parts of the world (Figure 1.3). According to the World Resources Institute, China ranked second (with 20 percent emissions) behind the United States (with 28 percent emissions) in the 2007 list of largest global emissions countries.⁸ Sectoral sources of GHG, as shown in Figure 1.2 are from energy, agriculture, forestry, and waste.

FIGURE 1.2 / Largest global CO₂ emitters



Source: World Bank, *East Asia Environmental Monitor: Adapting to Climate Change* (Washington, D.C. 2007) and IEA, *World Energy Outlook* (Paris, France, 2007) for energy except for Indonesia, which uses 2005 PIE data; 2005 USEPA data for agriculture; Houghton, J., "Modeling Technological Change in Climate Policy Analyses," *Energy Economics*, Vol. 28, Issue 5-6, November 2006 for forestry data; and 2005 USEPA data for waste.

FIGURE 1.3 / Emissions across the world



Source: Energy Information Administration (www.eia.doe.gov, 2007) for historical emissions; and IEA, *World Energy Outlook* (Paris, France, 2007) for projected emissions.

The International Red Cross and Red Crescent indicate that there is an increase in the intensity and frequency of disasters that climate change will only make worse.

The International Red Cross and Red Crescent indicate that there is an increase in the intensity and frequency of disasters that climate change will only make worse. For the period 1994–1998, reported disasters averaged 428 per year. That figure jumped to 707 during the period 1999–2003 with the greatest rise in developing countries where there was a devastating increase of 142 percent.⁹

The Primer discusses an approach to deal with climate change impacts and disaster risk management issues that runs on a dual track for a resilient community. One track is to inform local officials of the need to lower carbon emissions. This track is illustrated with sound practices from cities that have implemented mitigation programs for energy efficiency, the use of nonfossil fuels, controlled urban sprawl, improved public transport, waste recycling, and water reclamation. The other track addresses the consequences of climate change and the increased frequency and intensity of extreme events and disasters related to this change. Adaptive measures are discussed to prepare for and control the conditions and disasters that climate change will only make worse. A resilient community is one that maintains a current information base to understand potential hazards, and is well informed in the preparation and implementation of its future growth and improvement plans. A resilient community also collects and reserves the financial resources required from a variety of sources, including national capital markets for climate change mitigation and adaptation initiatives as well as for response and reconstruction in times of natural disasters, especially earthquakes, floods, and storm surges endemic to the East Asia Region.

Through self-assessment and participatory activities, the Primer facilitates city governments and their stakeholders in identifying assets and liabilities and how climate change may impact them.

The Primer promotes the notion of investing in adaptation, preparedness, and mitigation through actions and investment programs as sound urban management for resilient communities. Successful initiatives to address climate change impacts and disasters will require human, technical, and financial resources. The Primer will guide users through city assessments and participatory activities in an exercise to consolidate a City Information Base and review local government organizations. City Profiles present successful approaches to building local expertise and teams. Incentives presented as sound practice are useful to engage the private sector and civil society in behavior and technology change. It is critical that the definition of urban infrastructure must be expanded from just basic services to include climate change impact and hazard management investments for a resilient built environment.

C/ DEVELOPING A RESILIENT CITY OF THE FUTURE

The urban world is at a unique moment in time, especially in the East Asia Region. Three social, political, and financial movements are coming together in ways that will define future cities. The three movements are *urbanization*, *decentralization*, and *domestic capital market development*. How a city is structured to manage its growth and vulnerabilities is critical. A city's access to domestic capital markets opens up opportunities to reduce its dependence on uncertain and/or politically motivated national government grants, subsidies, and allocations. Cities are implementing their identified priorities with capital improvement programs through a stream of dedicated resources.



Climate change will impact future city spatial patterns, growth, and development. The world's population is moving to cities; one-half of the global population is already urban. By 2030 at least 61 percent of the world's population will be living in cities. Cities of the developing world will absorb 95 percent of all urban growth and will be home to almost 4 billion people, or 80 percent of the world's urban population. What was once dispersed rural poverty is now concentrated in urban informal and squatter settlements. Asia holds more than one-half of the world's slum populations of 581 million.¹⁰ By 2015, 12 out of the largest 15 cities in the world will be in developing countries, and 4 of those will be in Asia.

The concentration of population in cities increases opportunities for people as well as their vulnerabilities to natural hazards, civil strife, and climate change impacts. In East Asia there are more than 30 mega cities (with populations of more than 5 million). The map in Figure 1.4 shows that most of the mega cities are in vulnerable areas for climate change (coastal cities) and with high disaster risks, as shown in Figure 1.5. The map in Figure 1.5 shows that seismic and climatic natural disasters are likely to occur mostly in Asia. Higher risk zones are in red for seismic events and in blue for climatic events.

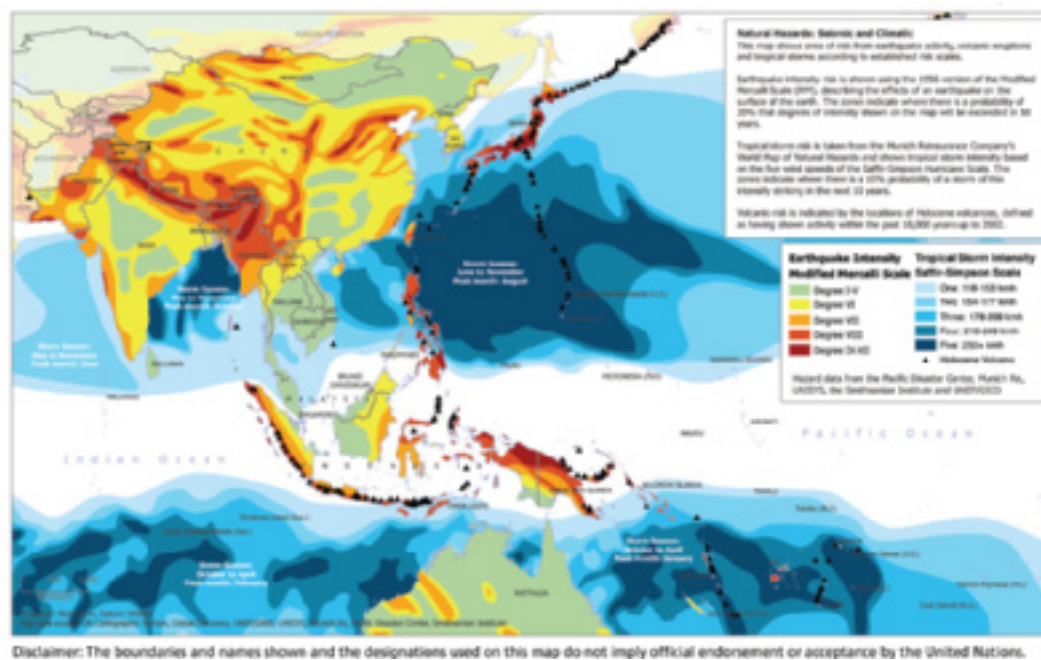
FIGURE 1.4 / Mega cities in East Asia



Source: Gill, I., and H. Kharas, *An East Asian Renaissance: Ideas for Economic Growth* (Washington, D.C.: World Bank, 2007).

FIGURE 1.5 / Natural hazards: Seismic and climatic

Source: Map provided courtesy of the United Nations Office for the Coordination of Humanitarian Affairs, Regional Office for Asia and the Pacific (OCHA ROAP), <http://ochaonline.un.org/>

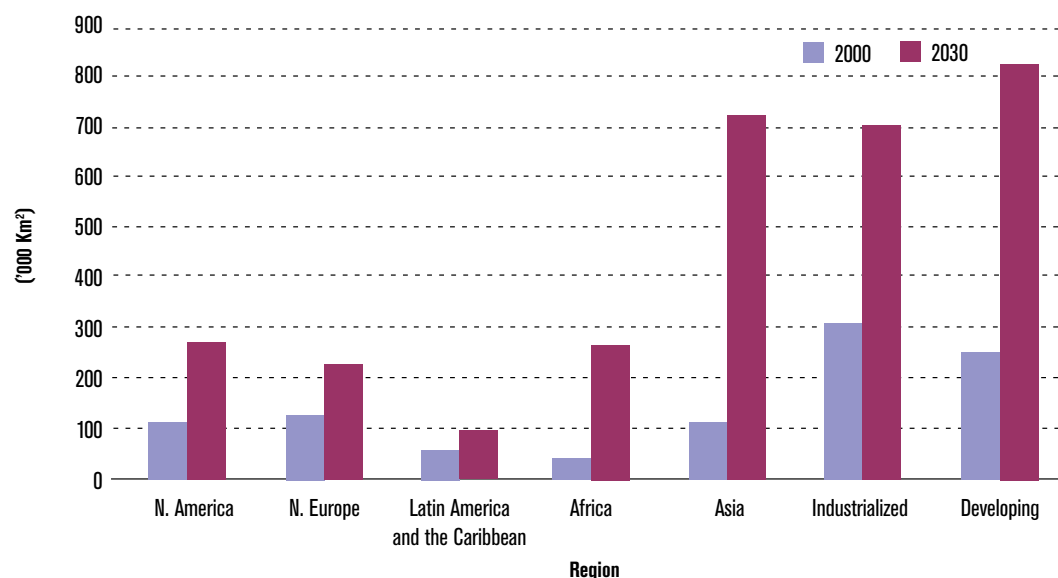


The lack of integrated land use and transport policies often do not allow for efficient, compact cities to develop.

Climate-related vulnerability increases not only from flooding due to more precipitation and storm surges, landslides, drought, saltwater intrusion, and typhoons, but also because of earthquakes and other similar hazards, particularly where poor quality and ill-maintained infrastructure, low-quality building stock, and lower resilience of the high-density society come into play. For example, out of the 10 most populous cities in the world, Tokyo/Yokohama, Seoul/Inchen, Osaka/Kobe/Kyoto, Metro Manila, and Jakarta, all in East Asia, have moderate to high earthquake hazard.¹¹ Similarly, Of these, most are located on the coast and are vulnerable to storm surges and tsunami waves. Resilient cities need to develop plans with climate change in mind—new shelter options that are not located on marginal land in flood plains and steep slopes, at densities that control urban sprawl.

If average densities continue to decline, doubling of the developing world's urban population by 2030 will result in a tripling of their built-up areas. It is projected that Asia will see the largest increase during this time (Figure 1.6). While some of this increase is the natural consequence of urban population growth, inefficient land use and planning policies are partly to blame for urban sprawl. Furthermore, the lack of integrated land use and transport policies often do not allow for efficient, compact cities to develop with clusters of high-density nodes that can support mass transit options and efficient grouping of residential developments, commercial services, and centers of employment. This would create lower transit emissions, less energy-intensive development, and proximity to shelters and services in the case of emergencies.



FIGURE 1.6 / Built-up area projections by region

Source: Angel, S., S.C. Sheppard, and D.L. Civco, *The Dynamics of Global Urban Expansion* (Washington, D.C.: World Bank, 2005).

What can a city do about warming temperatures, rising sea levels, and more frequent storms? Cities are experiencing these consequences caused by increased levels of heat trapped in the atmosphere that modify weather patterns. While changes in average conditions can have serious consequences by themselves, the main impacts of climate change will be felt due to weather extremes and the consequent risk of natural disasters. For East Asia this means more frequent and intense floods, storm surges, and winds.¹²

Decentralization, an ongoing force in East Asia, represents a major shift in the way cities are managed. Local governments are now being endowed with responsibilities for self-managing as they struggle for the required authority to do so in a successful manner. Accessing domestic capital markets can make a difference in the way cities are governed. Addressing climate change impacts in city plan development requires capital, and the domestic capital market provides an attractive avenue for resources for sustainable programs to reduce climate change impacts.

D/ MAINSTREAMING POLICY AND PRACTICE FOR LOCAL IMPACT

The approach to dealing with climate change has focused on national or regional plans to reduce contributions to global warming. Much of this will be implemented in urban areas. However, climate change impacts and natural hazards challenge the resilience of cities (Table 1.1) and are, in their essence, urban governance and management issues.

Local governments are now being endowed with responsibilities for self-managing as they struggle for the required authority to do so in a successful manner.

TABLE 1.1 / Possible impacts of extreme climate change relevant to urban areas (mostly adverse in East Asia)

Source: IPCC, Synthesis Report – Summary for Policymakers. Assessment of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC: Cambridge University Press, 2007).

Projected change in extreme climate phenomena and their likelihood	Consequences of climate change
Warmer with fewer cold days and nights, warmer and more frequent hot days and nights (virtually certain)	<ul style="list-style-type: none"> ❑ Heat island effect ❑ Increased demand for cooling ❑ Declining air quality in cities ❑ Effects on winter tourism ❑ Reduced energy demand for heating (a short-term benefit but not in East Asia) ❑ Reduced disruption to transport due to snow, ice (a short-term benefit, but not in East Asia)
Warm spells/heat waves. Frequency increases over most land areas (very likely)	<ul style="list-style-type: none"> ❑ Increased water demand ❑ Water quality problems ❑ Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially isolated ❑ Reduction in quality of life for people in warm areas without appropriate housing
Heavy precipitation events. Frequency increases over most areas (very likely)	<ul style="list-style-type: none"> ❑ Adverse effects on quality of surface and groundwater ❑ Contamination of water supply ❑ Increased risk of deaths, injuries, and infectious, respiratory, and skin diseases ❑ Disruption of settlements, commerce, transport, and societies due to flooding ❑ Large displacement of people ❑ Pressures on urban and rural infrastructures ❑ Loss of property ❑ Water stress may be relieved (short-term benefit)
Intense tropical cyclone activity increases (likely)	<ul style="list-style-type: none"> ❑ Power outages ❑ Distress migration to urban areas ❑ Disruption of public water supply ❑ Increased risk of deaths, injuries, water and food-borne diseases; post-traumatic stress disorders ❑ Disruption by flood and high winds ❑ Withdrawal of risk coverage in vulnerable areas by private insurers ❑ Potential for population migrations ❑ Loss of property
Increased incidence of extreme high sea level (excludes tsunamis) (likely)	<ul style="list-style-type: none"> ❑ Decreased freshwater availability due to saltwater intrusion ❑ Increased risk of deaths and injuries by drowning in floods and migration-related health effects ❑ Loss of property and livelihood ❑ Permanent erosion and submersion of land ❑ Costs of coastal protection versus costs of land-use relocation ❑ Potential for movement of populations and infrastructure

A supportive institutional and policy environment at the state and national levels can enable local adaptation. Mainstreaming these issues into policy and practice leads to holistic rather than sectoral engagement in climate change. Cities act cross-sectorally, a critical approach for dealing with climate change and disaster management. In this context, mainstreaming implies integrating awareness of future climate change impacts into existing and future policies and plans of developing countries, as



Natural hazard risks vary for city “types” – mountainous, inland plateaus, arid plains, coastal, adjacent to major rivers, or those along fault lines – but these risks can be managed to build communities of resilience.

well as those of multilateral organizations. At the national and regional level, mainstreaming shifts responsibility for implementing change-response strategies from single ministries or agencies dealing with climate change (such as environmental departments) to all sectors of government, civil society, academia, and the private sector¹³. Similarly, mainstreaming requires that the division of local-level responsibility between the separate and distinct entities of a Sustainability Office and a Disaster Management Office should be integrated for a more comprehensive strategy to reduce carbon emissions and create effective responses to disasters and the consequences of climate change.

Local governments must be better informed to confront the potential impacts of climate change. Equally important will be the need to promote changes in technologies, citizen participation, and urban growth patterns all important parts of the behavior of urban populations that contribute to global warming and create vulnerabilities to disasters.

E/ THE RISKS OF DOING NOTHING

As exemplified in the City Profiles, proactive leadership in dealing with climate change impacts mitigation, and adaptation are an exercise in good local government resource management practice. Leadership in Seattle (King County, Washington, USA), Singapore, Tokyo, and other cities,

The risks of “doing nothing” can have disastrous consequences. ▶



who are dealing with potential climate change impacts, sum up their attitude about the uncertain future as their “no-regrets” policy. No-regrets policies and actions are those that make good sense to implement whether or not the consequences of climate change turn out to be as projected. These endeavors thus discount the uncertainty generated by climate change projections and predictions by supporting adaptation and mitigation strategies along with hazard-specific response capacity building. The strategies, plans, and activities are the cornerstone for sound planning.

Fear of change fuels resistance to the idea of climate change and thus action, especially in the industrialized world. Preventing a reduction in the standard of living is often the justification for inaction. Such a position denies the fact that, without action to address potential climate change impacts, the standard of living will suffer far worse consequences. What will become of natural resources if we do not learn to do more with less, or at least differently, especially related to water? How do we cope with increasing demands for energy if we are not generating more from sources other than fossil fuels? These are just a couple of risks to the standard of living that industrialized countries cherish and developing countries may adopt soon.

Climate change impacts and consequences can wipe out development gains and significantly reduce the standard of living. The recent cyclone that devastated Myanmar affected the lives of more than 2.4 million people and caused estimated damage in the billions of dollars. In the 1990s, disasters killed almost seven times more people in developing countries than in industrialized countries.¹⁴

The GDP will be affected by climate change impacts on water security, with increased competition for supply among urban water users, including domestic water supply and industrial and commercial usage. The GDP will also be affected by macro water policy that has favored agriculture and

irrigation over urban use. The unregulated distribution of water to agriculture in neighboring states continues to over-draw on the supply forcing Delhi, India, into a severe water shortage. The once free-flowing Yamuna River that supplied Delhi has been reduced to a slow trickle of sludge. The Mekong River provides water to the six countries through which it runs and borders—Cambodia, China, Myanmar, Lao PDR, Thailand, and Vietnam. Increased temperature in this region will increase evaporation and transpiration by 10–15 percent, affecting the Mekong’s supply of water to the towns and cities that now depend upon it.

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SECTION

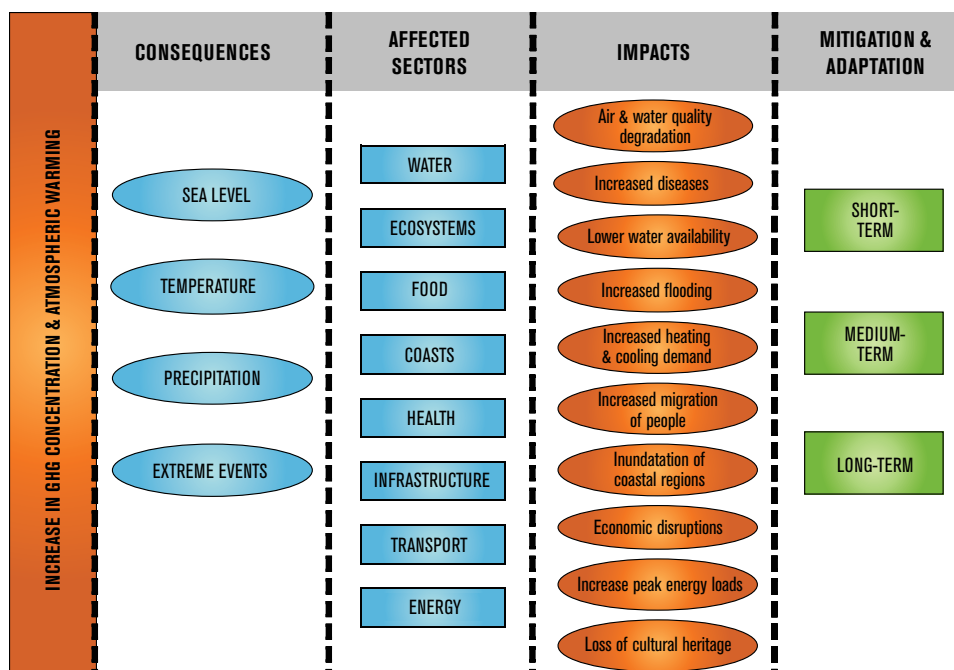
02



Explaining Climate Change Impacts and Disaster Risk Management

This section introduces the concepts, characteristics, issues, and potential impacts of climate change and disaster risk management. Potential climate change impacts are futuristic in nature; based on model scenarios, climate change impacts relate directly to disaster risk management. Presented as a Primer tool for relating consequences and sectors, Figure 2.1 allows you to make connections between and among the different elements to create innovative associations to stimulate discussion and investigation of issues perhaps not yet considered.

FIGURE 2.1 / Linking consequences and sectors with potential impacts and climate change mitigation and adaptation options



OBJECTIVE OF SECTION 02:

- Understand the issues and parameters of climate change and disaster risk management and also what potential global consequences and impacts affect East Asia and its cities.

OUTCOMES OF SECTION 02:

- Develop an understanding of the concepts of climate change and its impact for future training of other officials.
- Learn about clear, short “climate change sound bites” for training and outreach.
- Understand how climate change and extreme events are linked.

The Intergovernmental Panel on Climate Change (IPCC) has stated that increases in GHG concentration and climate system warming are happening, and that a delay in reducing GHG emissions significantly limits opportunities to achieve lower stabilization levels. This delay is likely to increase the risk of more severe climate change impacts. The IPCC has developed low-, medium-, and extreme-range global scenarios for potential climate conditions to help guide future planning.

The rapid change in climate, caused by the buildup of GHG in the atmosphere, will leave ecosystems vulnerable and will affect lives and livelihoods through sea-level rise; increased intensity of storms, cyclones, drought, and flooding; greater frequency of heat and cold waves; more rapid spread of respiratory, vector, and water-borne diseases; greater population displacement; and more conflicts over scarce resources.¹⁵ Climate change poses a particular threat to countries with heavy concentrations of population and economic activity in fragile and vulnerable regions, such as coasts, deltas, and low-lying areas.¹⁶

The major implications of climate change can be structured in three distinct but highly interrelated categories:

- Environment. Changes in coastal and marine systems, forest cover, and biodiversity;
- Economic. Threat to water security, impacts on agriculture and fisheries, disruption of tourism, and reduced energy security—all of which could have negative impacts on GDP; and
- Social. Population displacement, loss of livelihood, and increased health problems.

The impact of climate change in each of these categories will be manifested in the form of more severe and frequent disasters. Epidemics, as well as floods, drought, and other meteorological disasters, are expected to occur more frequently. The economic and social impacts of climate change are expected to significantly reduce the resilience of cities and/or their ability to respond to earthquakes and other devastating events. Climate change management is thus inextricably linked to strengthening disaster risk management capacity in cities.

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Global climate change has implications for the East Asia and the Pacific (EAP) Region, already vulnerable to the impacts of natural disasters and extreme climatic events. The Region has very high risk of earthquakes, volcanoes, and tsunamis. The recent earthquakes, including the May 2008 Wenchuan earthquake that hit China, illustrate the devastation these catastrophic events can cause. It is especially important to point out the vulnerabilities of schools in the EAP Region. As a result of China's May 12, 2008, Sichuan province earthquake, thousands of students were crushed in schools that collapsed because of poor construction. On a global scale, EAP is likely to be the Region most severely affected by sea-level rise (SLR). A projected 1-meter SLR could lead to a 2 percent loss of GDP and 1 percent agricultural land depletion. Anything higher would have even more significant impact on urban areas and wetlands. Vietnam, China, Myanmar, and Thailand are expected to be most affected by sea-level rise.¹⁷ Thus, in EAP, climate change can undermine progress in advancing economic growth and reducing poverty and can compound environmental degradation. Moreover, the intensity and frequency of these extreme events is expected to increase. Given these expected changes, there is now a need to develop appropriate mitigation and adaptation responses, including retrofitting existing buildings, especially public buildings and schools.



In the EAP Region, the urban population is projected to nearly double between 2000 and 2030, from 665 million to 1.2 billion people. EAP cities account for high percentages of economic activities, and climate change may have a dramatic impact on social and economic figures.¹⁸ Per capita GDP of Ho Chi Minh City is more than three times Vietnam's national average; the per capita GDP of Shanghai is five times China's national average; incomes in Greater Jakarta, Seoul, and Bangkok are at least 80 percent higher than in surrounding areas. Ensuring that cities in the Region continue to drive growth in a sustainable manner is fundamental to the region's continual development and poverty eradication.

As these cities vie globally to attract private sector resources, issues like slum growth, physical security, and exposure and vulnerability to natural hazards can influence investment decisions. These issues must be addressed strategically in order for cities to maintain their growth rate and investment opportunities and ability to continue poverty reduction efforts. An important adaptation strategy for local governments is to provide new shelter options for the poor to avoid settlements on marginal land and the creation of new slums.

It is evident that neither mitigation nor adaptation alone can guard against all climate change impacts. However, they can complement each other and together address part of the risks of climate change. Adaptation is necessary in the short and longer term to address impacts resulting from warming that would occur even for the lowest IPCC-assessed carbon stabilization scenarios. There are barriers, limits, and costs, but these are not fully understood. The time at which such limits could be reached will vary between sectors and regions. Unmitigated climate change would, in the long term, likely exceed the capacity of natural and human systems to adapt. Early mitigation actions would reduce climate change and associated adaptation needs.

Climate change can undermine progress in advancing economic growth and reducing poverty and can compound environmental degradation.

A/ WHAT IS MITIGATION (CLIMATE CHANGE MANAGEMENT)?

Global GHG emissions have increased 70 percent between 1970 and 2004. Mitigation attempts to slow the process of global climate change by lowering GHG levels in the atmosphere. With current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades.

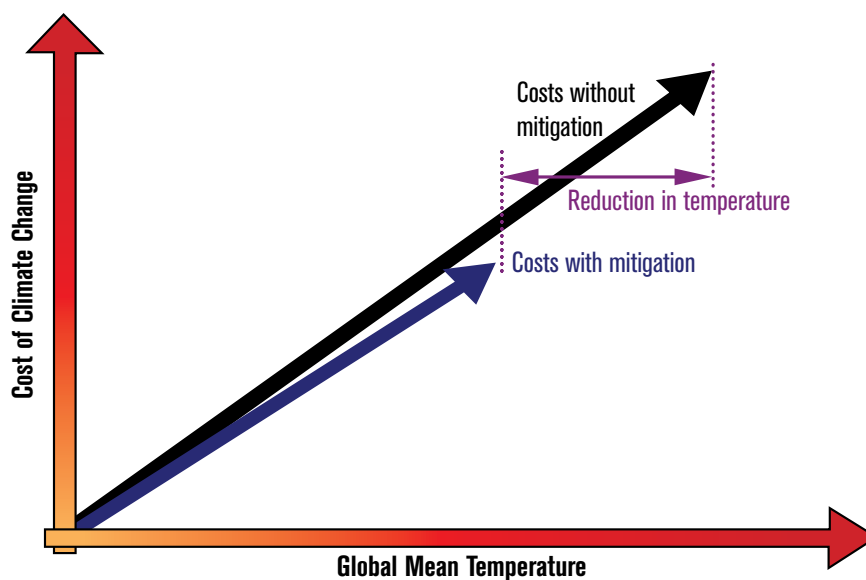
Reducing the production of GHGs would result in improvements to the regional environment and could contribute to better health and well-being and to economic efficiencies in households and businesses. Studies indicate that there is evidence of substantial positive economic impacts from the mitigation of global GHG emissions over the coming decades that could offset the projected growth of global emissions or reduce emissions below current levels.¹⁹ Figure 2.2 shows the relationship between global temperature rise and the costs of climate change. Mitigation reduces GHG emission and over time reduces the extent of increase in mean global temperature. This correspondingly reduces the cost of climate change.

No single technology can provide all the mitigation potential in any sector. The economic mitigation potential, which is generally greater than the market mitigation potential, can be achieved only when adequate policies are in place and barriers are removed. There are a wide variety of policies



FIGURE 2.2 / Mitigation effect in reducing the increase in global mean temperature and climate change cost

Source: Adapted from Stern, N., *Stern Review on the Economics of Climate Change* (Cambridge: Cambridge University Press, 2006).



and instruments available to governments to create the incentives for mitigation action (i.e., regulations and standards, taxes and charges, tradable permits, financial incentives, voluntary agreements, information instruments, and research and development). Their applicability depends on national circumstances and sectoral context. It is also found that changes in lifestyle, behavior patterns, and management practices can potentially make significant contributions to climate change mitigation across all sectors.

Many options for reducing global GHG emissions through international cooperation already exist. Notable achievements of the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol are the establishment of a global framework to respond to climate change, the stimulation of national measures and policies, and creation of an international carbon market and new institutional mechanisms that could provide the foundation for future mitigation efforts. General findings about the performance of climate change policies are given in Box 2.1.

Source: Adapted from UNFCCC website <http://www.unfccc.org>.

Box 2.1 General findings about the performance of climate change policies

- Integrating climate policies in broader development policies makes implementation and overcoming barriers easier.
- Regulations and standards generally provide some certainty about emission levels. They may be preferable to other instruments when information or other barriers prevent producers and consumers from responding to price signals. However, they may not induce innovations and more advanced technologies.
- Taxes and charges can set a price for carbon but cannot guarantee a particular level of emissions. The literature identifies taxes as an efficient way of internalizing costs of GHG emissions.

Box 2.1 (cont.)

- Tradable permits will establish a carbon price. The volume of allowed emissions determines their environmental effectiveness while the allocation of permits has distributional consequences. Fluctuation in the price of carbon makes it difficult to estimate the total cost of complying with emission permits.
- Financial incentives (subsidies and tax credits) are frequently used by governments to stimulate development and diffusion of new technologies. While economic costs are generally higher than for the instruments listed above, they are often critical to overcome barriers.
- Having played a role in the evolution of many national policies, voluntary agreements between industry and governments are politically attractive and raise awareness among stakeholders. The majority of agreements have not achieved significant emissions reductions beyond business as usual.
- Some recent agreements in a few countries have accelerated the application of best-available technology and led to measurable emission reductions.
- Information instruments (e.g., awareness campaigns) may positively affect environmental quality by promoting informed choices and possibly contributing to behavioral change; however, their impact on emissions has not been measured yet.
- Research and development can stimulate technological advances, reduce costs, and enable progress toward stabilization.

In several sectors, climate response options can be implemented to realize synergies and avoid conflicts with other dimensions of sustainable development. Decisions about macroeconomic and other non-climate policies can significantly affect emissions, adaptive capacity, and vulnerability. There is a need to adopt a holistic approach considering all the possible instruments that consider mitigation as an element of sustainable development.

On the one hand, making development more sustainable can enhance mitigative and adaptive capacities, reduce emissions, and reduce vulnerability; but there are many barriers to implementation. On the other hand, it is very likely that climate change can slow the pace of progress toward sustainable development. In order to stabilize the concentration of greenhouse gases in the atmosphere, emissions would need to peak and decline thereafter.²⁰ The lower the desired stabilization level, the more quickly this peak and decline would need to occur. Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Table 2.1 gives a variety of national, regional, and local mitigation policies and instruments, presenting also some examples of applications per sector. The table also presents key constraints and opportunities that these measures, policies and instruments may cause when applied at the city level.

TABLE 2.1/ Selected examples of key sectoral mitigation technologies, policies and measures, constraints, and opportunities pertaining to urban areas

Source: IPCC, Climate Change 2007: Synthesis Report – Summary for Policymakers. Assessment of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC: Cambridge University Press, 2007).

Sector	Key mitigation technologies and practices currently commercially available	Policies, measures, and instruments shown to be environmentally effective	Key constraints (-) or opportunities (+)
Energy supply (e.g., Singapore, Albuquerque, King County/Seattle)	Improved supply and distribution efficiency; fuel switching from coal to gas; nuclear power; renewable heat and power (hydropower, solar, wind, geothermal, and bio-energy); combined heat and power; early applications of CO ₂ capture and storage (e.g., storage of removed CO ₂ from natural gas).	Reduction of fossil fuel subsidies; taxes or carbon charges on fossil fuels.	(-) Resistance by vested interests may make them difficult to implement.
		Feed-in tariffs for renewable energy technologies; renewable energy obligations; producer subsidies.	(+) May be appropriate to create markets for low emissions technologies.
Transport (e.g., London, Singapore, Milan)	More fuel-efficient vehicles; hybrid vehicles; cleaner diesel vehicles; bio-fuels; modal shifts from road transport to rail and public transport systems; nonmotorized transport (cycling, walking); land-use and transport planning.	Mandatory fuel economy; bio-fuel blending and CO ₂ standards for road transport.	(-) Partial coverage of vehicle fleet may limit effectiveness.
		Taxes on vehicle purchase, registration, use, motor fuels, and roads; parking pricing.	(-) Effectiveness may drop with higher incomes.
		Mobility influenced needs through land-use regulations and infrastructure planning; investment in attractive public transport facilities and nonmotorized forms of transport.	(+) Particularly appropriate for countries that are building up their transportation systems.
Buildings (e.g., Albuquerque, King County/Seattle, Dongtang)	Efficient lighting and day-lighting; more efficient electrical appliances and heating and cooling devices; improved cook stoves; improved insulation; passive and active solar design for heating and cooling; alternative refrigeration fluids; recovery and recycling of fluorinated gases.	Appliance standards and labeling.	(+) Periodic revision of standards needed.
		Building codes and certification.	(-) Attractive for new buildings. (-) Enforcement can be difficult.
		Demand-side management programs.	(+) Need for regulation so that utilities may profit.
		Public sector leadership programs, including procurement.	(+) Government purchasing can expand demand for energy-efficient products.
		Incentives for energy service companies.	(+) Success factor: access to third-party financing.



TABLE 2.1/ (cont.)

Sector	Key mitigation technologies and practices currently commercially available	Policies, measures, and instruments shown to be environmentally effective	Key constraints (-) or opportunities (+)
Industry (e.g., Singapore, Albuquerque)	More efficient end-use electrical equipment; heat and power recovery; material recycling and substitution; control of non-CO ₂ emissions; wide array of process-specific technologies.	Provision of benchmark information; performance standards; subsidies, tax credits.	(+) May be appropriate to stimulate technology uptake. (+) Stability of national policy important in view of international competitiveness.
		Tradable permits.	(+) Predictable allocation mechanisms and stable price signals important for investment.
		Voluntary agreements.	(+) Success factors include clear targets, a baseline scenario, third-party involvement in design and review and formal provisions for monitoring. (+) Close cooperation between government and industry.
Waste (e.g., Singapore, Albuquerque, King County/Seattle)	Landfill methane recovery; waste incineration with energy recovery; composting of organic waste; controlled wastewater treatment; recycling and waste minimization.	Financial incentives for improved waste and wastewater management.	(+) May stimulate technology diffusion.
		Renewable energy incentives or obligations.	(+) Local availability of low-cost fuel.
		Waste management regulations.	(+) Most effectively applied at the national level with enforcement strategies.

B/ WHAT IS MITIGATION (DISASTER RISK MANAGEMENT)?

Disaster risk management recognizes that the consequences of natural hazards and climate change impacts can be reduced through mitigation and preparedness. The United Nations International Strategy for Disaster Reduction (UNISDR) refers to mitigation as “structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation, and technological hazards.”²¹

Mitigation includes actions that reduce the severity of future disasters. These include structural mitigation actions such as improvement in city zoning regulations and building codes, and non-

structural mitigation measures such as implementing school safety programs and public awareness programs. Preparedness actions include the city's contingency plans for flexible deployment of staff and hospital preparedness. A critical element of disaster risk management is a system of quick response to minimize casualties in the event of a disaster. These actions include creating fully equipped emergency response teams. It is now widely accepted that disaster risk management requires actions on all aspects including mitigation, preparedness, and response.

Disaster risk management plans are prepared for optimal utilization of resources in the context of an expected disaster. For disasters that occur at regular intervals, the consequences are well known and informative to risk management plans. Low-probability disasters such as earthquakes and tsunamis typically use information from their previous events or observation-based consequences in other similar cities around the world. Developing and implementing disaster risk management programs therefore provide cities with an opportunity to understand their disaster history and capacities better, and also facilitate shared learning and joint understanding with other cities. The changing hazard profile due to climate change can have a profound impact on the disaster risk management plans of cities; however, such plans are not adequately considered in major cities around the world.

▼ *A critical part of disaster mitigation, preparedness, and response is community education and mobilization.*



The actions and programs for disaster risk management are most effective if they are suitably integrated with the corresponding programs of all actors in a city. For example, a structural mitigation program to improve building codes is effective only if the building permit department incorporates the modifications as a part of its routine activity. The integration of programs in regular activities of the various functions of the cities and other stakeholders is known as “mainstreaming.” It is recognized that mainstreaming is an essential requirement for effective and sustainable disaster risk management programs.

Disaster risk management strategies and commitments have been internationally accepted through the adoption of the Hyogo Framework for Action in 2005. The Hyogo Framework has three strategic goals, as outlined below and in table 2.2.

- More effective integration of disaster risk considerations into sustainable development policies, planning, and programming at all levels, with a special emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction;
- Development and strengthening of institutions, mechanisms, and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards; and
- Systematic incorporation of risk reduction approaches into the design and implementation of emergency preparedness, response, and recovery programs in the reconstruction of affected communities.

Mainstreaming is an essential requirement for effective and sustainable disaster risk management programs.

Strategic goals	Suggested indicators
1. Integration of disaster risk reduction into sustainable development policies and practices.	<ul style="list-style-type: none"> □ National development plans and their local counterparts include elements which address disaster risk reduction. □ All international plans and programs for cities, such as: <ol style="list-style-type: none"> (a) poverty reduction strategies, (b) common programming tools of the UN and international agencies, (c) climate change adaptation plans and strategies, and (d) donor-supported country development assistance programmes include elements which address disaster risk reduction.
2. Development and strengthening of institutions, mechanisms and capacities to build resilience to hazards	<ul style="list-style-type: none"> □ A policy framework for disaster risk reduction exists that includes policies, plans, and activities for national to local administrative levels. □ A multi-sectoral platform for disaster risk reduction is functioning. □ Dedicated and sufficient resources are available for planned activities to reduce disaster risks.
3. The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programs.	<ul style="list-style-type: none"> □ The policy framework incorporates disaster risk reduction into the design and implementation of emergency, response, recovery and rehabilitation processes. □ Post-disaster reviews are routinely undertaken to learn lessons on risk reduction and these lessons are incorporated into plans and preparedness for response.

TABLE 2.2/
Indicators of the Hyogo Framework for Action and strategic goals

Source: UNISDR, Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action (Geneva, Switzerland, 2008).

These strategic goals can be achieved through various actions and programs. The Hyogo Framework for Action has identified five priorities that are essential for achieving its strategic goals; these are:

- Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation;
- Identify, assess, and monitor disaster risks and enhance early warning;
- Use knowledge, innovation, and education to build a culture of safety and resilience at all levels;
- Reduce the underlying risk factors; and
- Strengthen disaster preparedness for effective response at all levels.

These priorities have very strong relevance for cities. The programs emerging from these priorities can cover the entire spectrum of disaster risk management activities from mitigation to response. UNISDR has suggested indicators for measuring the compliance with the Hyogo Framework for Action strategic goals and priorities. The main indicators of interest to cities are given in Table 2.3; while many are national level indicators, they can easily be adapted to the city level.

TABLE 2.3/
Indicators for Hyogo
Priorities for Action

Source: UNISDR, Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action (Geneva, Switzerland, 2008).

Priority for action	Suggested indicators
1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation	<ul style="list-style-type: none"> □ National institutional and legal frameworks for disaster risk reduction exist with decentralized responsibilities and capacities at all levels. □ Dedicated and adequate resources are available to implement disaster risk reduction plans at all administrative levels. □ Community participation and decentralization is ensured through the delegation of authority and resources to local levels. □ A national multisectoral platform for disaster risk reduction is functioning.
2. Identify, assess, and monitor disaster risks and enhance early warning.	<ul style="list-style-type: none"> □ National and local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors. □ Systems are in place to monitor, archive, and disseminate data on key hazards and vulnerabilities. □ Early warning systems are in place for all major hazards, with outreach to communities. □ National and local risk assessments take account of regional/transboundary risks, with a view to regional cooperation on risk reduction.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.	<ul style="list-style-type: none"> □ Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information-sharing system, etc.). □ School curricula, education materials, and relevant training include risk reduction and recovery concepts and practices. □ Research methods and tools for multirisk assessments and cost-benefit analysis are developed and strengthened. □ Countrywide public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.



TABLE 2.3/ (cont.)

Priority for action	Suggested indicators
4. Reduce the underlying risk factors.	<ul style="list-style-type: none"> ❑ Disaster risk reduction is an integral objective of environment-related policies and plans, including policies and plan for land use, natural resource management, and climate change adaptation. ❑ Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk. ❑ Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities. ❑ Planning and management of human settlements incorporate disaster risk reduction elements, including enforcement of building codes. ❑ Disaster risk reduction measures are integrated into post-disaster recovery and rehabilitation processes. ❑ Procedures are in place to assess disaster risk impacts of all major development projects, especially infrastructure.
5. Strengthen disaster preparedness for effective response at all levels.	<ul style="list-style-type: none"> ❑ Strong policy, technical and institutional capacities, and mechanisms for disaster management, with a disaster risk reduction perspective, are in place. ❑ Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programs. ❑ Financial reserves and contingency mechanisms are in place to enable effective response and recovery when required. ❑ Procedures are in place to exchange relevant information during disasters and to undertake postevent review.

C/ WHAT IS ADAPTATION?

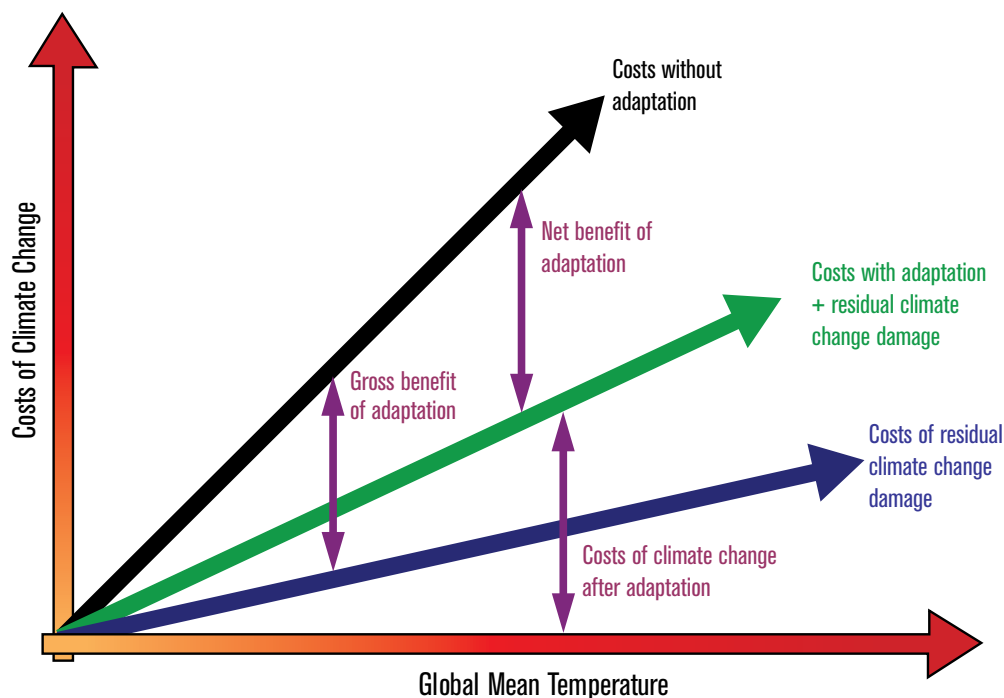
The IPCC Third Assessment Report refers to adaptation as an adjustment in natural or human systems to a new or changing environment.²² Figure 2.3 shows the relationship between costs of climate change and adaptation. Adaptation reduces the costs of climate change by reducing the damage due to climate change even though it does not influence the rise in global temperature. The net benefit of adaptation persists even after the costs of adaptation are added, illustrating that adaptation is always beneficial. Adaptation programs have other such advantages, such as making society more resistant to other disasters.

Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation. An array of adaptation options is available, but more extensive adaptation is required to reduce vulnerability to climate change than is occurring now. Expanding the options for adaptation also means better understanding of limits and costs.



FIGURE 2.3 / Relationship between the cost of adaptation and climate change

Source: Stern, N., *Stern Review on the Economics of Climate Change* (Cambridge: Cambridge University Press, 2006).



Societies have a long record of managing the impacts of weather- and climate-related events. Nevertheless, additional adaptation measures will be required to reduce the adverse impacts of projected climate change and variability, regardless of the scale of mitigation undertaken over the next two to three decades. Moreover, vulnerability to climate change can be exacerbated by other stresses. These arise from, for example, current climate hazards, poverty and unequal access to resources, food insecurity, trends in economic globalization, conflict, and incidence of diseases.

Some planned adaptation to climate change is already occurring on a limited basis. Adaptation can reduce vulnerability especially when it is embedded within broader sectoral initiatives. There is high confidence that there are viable adaptation options that can be implemented in some sectors at low cost, and/or with high benefit–cost ratios. However, comprehensive estimates of costs and benefits of adaptation need to be evaluated for each urban area.

The urban poor are typically at the highest risk in the event of natural disasters due to the location of low-income settlements. These settlements are often on sites vulnerable to floods and landslides, infrastructure is weak or lacking, and housing is substandard and prone to fire damage or collapse. The urban poor thus face threats to their lives, assets, and future prosperity due to an increase in risks of storms, floods, landslides, and extreme temperatures. Urban poor are also likely to get unequal distribution of scarce assets such as water, energy supply, and urban infrastructure, thereby increasing their vulnerability. Recovering from disasters is also particularly difficult for the poor as they do not have resources or adequate safety nets, and public policies often prioritize rebuilding in

other parts of the city.²³ Environmental- and climate change-related problems affect the urban poor disproportionately because of poor quality and overcrowded housing and the inadequacies in provision of water, sanitation, drainage, health care, and garbage collection.

The adaptive capacity of a society is intimately connected to its social and economic development. However, the adaptive capacity is unevenly distributed across and within societies. A range of barriers limit both the implementation and effectiveness of adaptive measures. The capacity to adapt is dynamic and influenced by a society's productive base, including natural and man-made capital assets, social networks and entitlements, human capital and institutions, governance, national income, health, and technology. Even societies with high adaptive capacity remain vulnerable to climate change, variability, and extreme events.

Early mitigation of GHG emissions will decrease future adaptation costs. However, even if efforts to stabilize GHG concentrations are relatively successful, some degree of warming and related impacts will continue to occur in the future. An effective response to city-level climate change must therefore combine both mitigation (to avoid the unmanageable) and adaptation (to manage the unavoidable).²⁴

There are synergies between successful climate change adaptation and successful local development. In urban areas, poverty reduction, including the provision of housing upgrading and basic civic infrastructure and services, is central to adaptation. Successful, well-governed cities greatly reduce climate-related risks for low-income populations.

All adaptation measures can be categorized into five categories and their combinations: (a) mobility, (b) storage, (c) diversification, (d) communal pooling, and (e) exchange. The effectiveness of these strategies is a function of the social and institutional condition of the city and needs to be designed to be region specific.

- **Mobility** is the most common adaptation response, such as relocation of a vulnerable population away from flood plains and landslide-prone slopes. Mobility may have extremely adverse social consequences if it is not planned as a part of an adaptation strategy due to the attendant social and political instability (such as when people are forced to relocate away from their livelihoods and social support system, or when they are unwanted in their new neighborhood).
- **Storage** refers to pooling of risks across time. Storage strategies are relevant to individual households and communities. If adequate high-quality urban infrastructure is provided to a community, the need for storage can be substantially reduced. Storage is most useful to address food and water scarcity in the immediate aftermath of a disaster. Several sound practices for storage exist, such as the 72-hour self-sustaining food supply that is recommended for each family by the disaster management plans in several cities.
- **Diversification** refers to pooling of risks across assets and resources of households and communities. Some good adaptation strategies include mixed land-use urban development plans so that the community has a mix of economic background, commercial activities, and employment opportunities.

The urban poor are typically at the highest risk in the event of natural disasters because of the location of low-income settlements.

- **Communal pooling** refers to pooling of assets and resources, sharing of incomes from particular activities across households, or mobilizing the use of resources that are collectively held during times of scarcity. Communal pooling spreads risks across households. It can take place through better interaction between the various stakeholders or communities that are likely to be affected by a disaster. The most common communal pooling programs are those that aim to develop community-level support groups or self-help groups. Micro-finance programs that pool community resources and provide support on the basis of need are another example of adaptation through communal pooling.
- **Exchange** is the most versatile adaptation response, and it is extremely important for urban areas. Exchange and market mechanisms, both formal and informal, are critical for economic development of the cities. Market-based or exchange adaptation includes provision of access to better and newer markets by the community. Programs that provide insurance to cover buildings that may be damaged due to earthquake or floods are examples of market-based adaptation practice. Market-based approaches also allow a city to monetize their assets, which can then be used to raise resources for undertaking various developmental and disaster risk management programs. This adaptation response therefore enables the community and the city to share risks with the much wider global community.

An illustrative list of national, regional, and local mitigation policies and instruments that have been suggested is shown in Table 2.4, which also presents some examples of applications in the water, energy, transport, building, and industry sectors. It also presents key constraints and key opportunities that these measures, policies and instruments may cause when applied at city level.

TABLE 2.4/ Selected examples of key sectoral adaptation opportunities pertaining to urban areas

Source: IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC: Cambridge University Press, 2007).

Sector	Adaptation option/strategy	Underlying policy framework	Key (–) constraints and (+) opportunities to implementation
Water (e.g., King County/Seattle, Singapore)	Expanded rainwater harvesting; water storage and conservation techniques; water reuse; desalination; water-use and irrigation efficiency	National water policies and integrated water resources management; water-related hazards management	(–) Financial, human resources, and physical barriers (+) Integrated water resources management; synergies with other sectors
Infrastructure and settlements (including coastal zones) (e.g., Venice, London, New York)	Relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea-level rise and flooding; protection of existing natural barriers	Standards and regulations that integrate climate change considerations into design; land-use policies; building codes; insurance	(–) Financial and technological barriers (+) Availability of relocation space; integrated policies and management; synergies with sustainable development goals

TABLE 2.4/ (cont.)

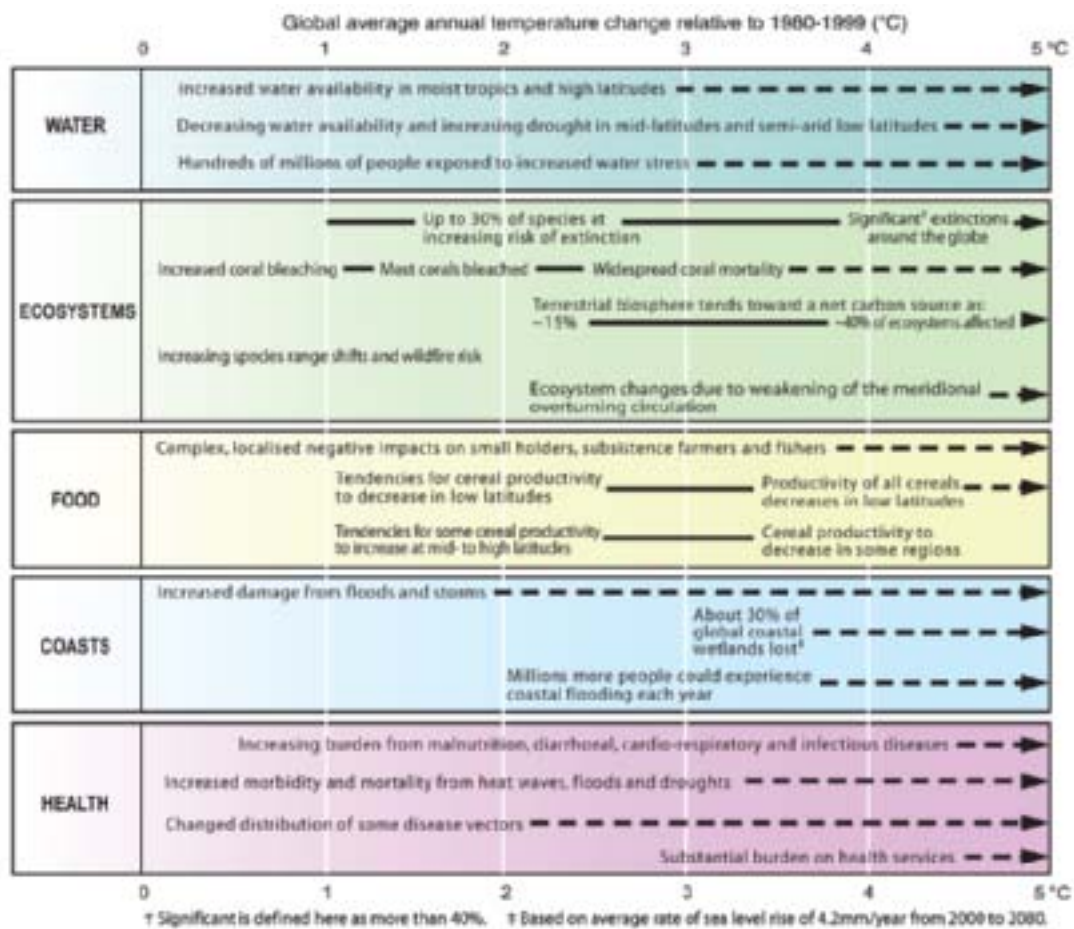
Sector	Adaptation option/ strategy	Underlying policy framework	Key (–) constraints and (+) opportunities to implementation
Human health (e.g., Singapore, New York)	Heat-health action plans, emergency medical services, improved climate-sensitive disease surveillance and control, safe water and improved sanitation	Public health policies that recognize climate risk; strengthened health services; regional and international cooperation	(–) Limits to human tolerance (vulnerable groups), (–) Knowledge limitations (–) Financial capacity (+) Upgraded health services, (+) Improved quality of life
Tourism (e.g.,Switzerland)	Diversification of tourism attractions & revenues, shifting ski slopes to higher altitudes and glaciers	Integrated planning (e.g., carrying capacity; linkages with other sectors); financial incentives, e.g., subsidies and tax credits	(+) Appeal/marketing of new attractions; (–) Financial and logistical challenges (–) Potential adverse impact on other sectors (e.g., artificial snow-making may increase energy use) (+) Revenues from 'new' attractions (+) Involvement of wider group of stakeholders
Transport (e.g., King County/Seattle, Albuquerque, Rockville, Singapore, Tokyo)	Realignment/relocation; design standards and planning for roads, rail, and other infrastructure to cope with warming and drainage	Integrating climate change considerations into national transport policy; investment in R&D for special situations, (e.g.,permafrost areas)	(–) Financial and technological barriers (+) Availability of less vulnerable routes (+) Improved technologies (+) integration with key sectors (e.g., energy)
Energy (e.g., King County/Seattle, Albuquerque, Rockville, Singapore, Tokyo)	Strengthening of overhead transmission and distribution infrastructure, underground cabling for utilities, energy efficiency, use of renewable sources, reduced dependence on single sources of energy	National energy policies, regulations, and fiscal and financial incentives to encourage use of alternative sources; incorporating climate change in design standards	(+) Access to viable alternatives (–) Financial and technological barriers (–) Acceptance of new technologies; (+) Stimulation of new technologies (+) Use of local resources

The Primer now looks at the main consequences of climate change, with a focus on sea-level rise, temperature change, precipitation change, resilience, and extreme events. The relationship between consequences and the extent of mean global temperature rise is shown in figure 2.4. When global annual temperature increases, several effects are likely to occur. The figure shows the potential impacts of a 5°C change in temperature to the water, ecosystems, food, coasts, and health sectors.



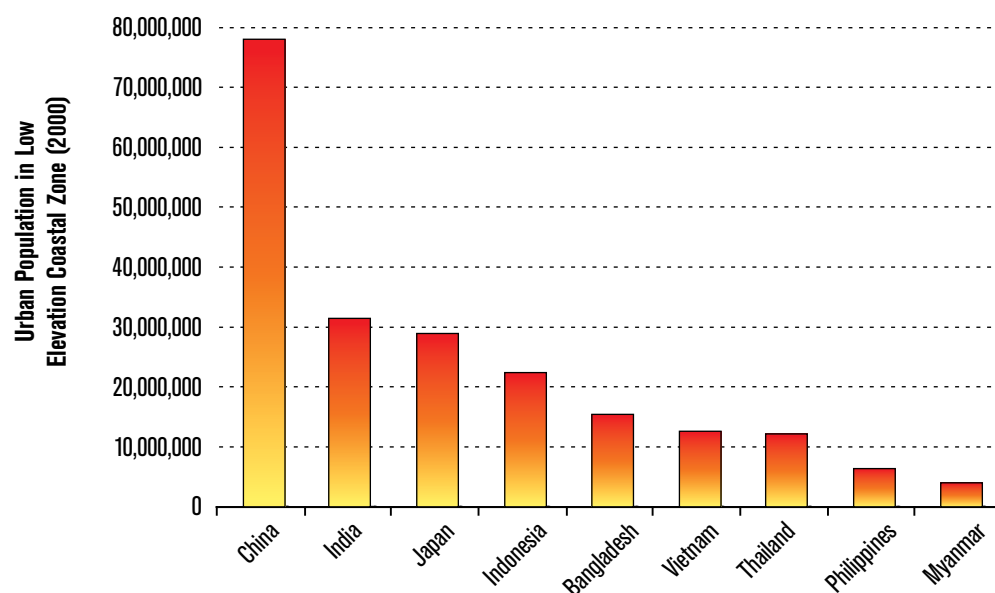
FIGURE 2.4/ Examples of impacts associated with global average temperature change

Note: Actual impacts will vary by extent of adaptation, rate of temperature change, and socio-economic pathway.
 Source: IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC: Cambridge University Press, 2007).



D/ WHAT ABOUT SEA-LEVEL RISE?

Sea-level rise is caused by the thermal expansion of seawater, storm surges, and rising and falling of land in coastal regions. Higher temperatures are expected to further raise sea level by expanding ocean water, melting mountain glaciers and small ice caps, and causing portions of Greenland and the Antarctic ice sheets to melt. The IPCC predicts that average sea levels will rise by about 18 centimeters by 2040 and by about 48 centimeters by 2100 in the most extreme case.²⁵ Populations all over the world will be affected. Figure 2.5 illustrates the coastal populations most highly vulnerable to sea-level rise in select countries, showing the highest vulnerability of East Asian countries, led by China.

FIGURE 2.5/ Coastal population of select countries that are highly vulnerable to sea-level rise

Source: G. McGranahan, D. Balk, and B. Anderson. Low Elevation Coastal Zone (LECZ) Urban-Rural Population Estimates, Global Rural-Urban Mapping Project (GRUMP), Alpha Version. Palisades, NY: Socioeconomic Data and Applications Center (SEDAC), Columbia University, 2007. Available at: <http://sedac.ciesin.columbia.edu/gpw/lec2.jsp>.

1. What Are the Effects and Impacts?

Rising sea levels inundate wetlands and other low-lying lands, erode beaches, intensify flooding, and increase the salinity of rivers, bays, and groundwater tables. Some of these effects may be further compounded by other effects of a changing climate. Regional-scale changes in general include the following:²⁶

- Warming (greatest) over land and at most high northern latitudes and (least) over the Southern Ocean and parts of the North Atlantic Ocean, continuing recent observed trends;
- Contraction of snow cover area, increases in thaw depth over most permafrost regions, and decrease in the extent of sea ice;
- Very likely increase in frequency of hot temperatures, heat waves, and heavy precipitation;
- Likely increase in tropical cyclone intensity, less confidence in global decrease of tropical cyclone numbers;
- Pole-ward shift of extratropical storm tracks with consequent changes in wind, precipitation, and temperature patterns; and
- Very likely precipitation increases in high latitudes and likely decreases in most subtropical land regions, continuing observed recent trends.

There is high confidence that by midcentury, annual river runoff and water availability are projected to increase at high latitudes (and in some tropical wet areas) and decrease in some dry regions in the midlatitudes and tropics.²⁷ There is also high confidence that many semi-arid areas (e.g., northern China, Inner Mongolia, Mediterranean Basin, western United States, southern Africa, and northeastern Brazil) will suffer a decrease in water resources due to climate change.



▲ *Port cities like Hong Kong must adopt sound practices to mitigate against and adapt to potential sea-level rise.*

2. What Are Some Mitigation and Adaptation Sound Practices?

Sea-level rise cannot be reduced through mitigation measures. The extent of sea-level rise therefore needs to be considered when deciding suitable adaptation measures. Singapore, for example, has decided to increase the ground level in all reclamation programs to factor the likely increase in sea-level due to climate change. The City of London has also factored sea-level rise in the redesign of the Thames Barrier flood control system. Shanghai has a flood control project: a two-phase project

that is designed to regulate water flow in the region to reduce flooding and provide a platform for water-quality monitoring. Shanghai's plan is being reviewed to become potentially the basis for a national water resource management model. It provides water-level data in real time, enabling the water authority to see conditions across the entire region as they develop and make decisions to protect areas downstream from flooding or overflow. The system optimizes operations with simultaneous control of all floodgates and pump stations in the region and provides a platform to cost-effectively modify or expand the system in the future. Should water levels reach flood stages, notification is sent to the central control office, allowing officials to take immediate action to remotely close the floodgates. Each station is also fitted with a video camera to provide visual confirmation of conditions, further reducing costs and the amount of staff required to oversee operations.

E/ WHAT ABOUT TEMPERATURE?

According to the IPCC middle-range scenario, the entire EAP Region will experience a rise of about 2.5°C in temperature by the end of the century. Temperatures have risen globally by 0.2–0.6°C in the past century. The highest temperature rises were in 1910–1945 and after 1975. According to projections by the IPCC in 1996, the average global air temperature will be 1°C higher by 2040 if no additional steps are taken to reduce CO₂ emissions and other greenhouse gases. By 2100 temperatures will increase by another 1.5°C. Even if current GHG emissions would suddenly stop, temperatures on Earth would still rise at least 0.5°C before stabilizing in 2050.²⁸ Later assessments have reinforced these projections.

Total amounts of global rainfall will increase; however, rainfall patterns may change with time due to climate change. There will be regions that will receive less rainfall than before the changes

took place. Annually, the number of days of intense rain showers or very high temperatures will both increase.²⁹

1. *What Are the Effects and Impacts?*

Manifestations of climate change will include the following:

- Winter temperatures will change more than summer temperatures;
- Minimum daily temperatures will rise more than maximum daily temperatures;
- Land will warm more than oceans, causing stronger monsoon activity;
- Higher latitudes and altitudes will experience greater warming; and
- The number of frost days will decrease, and precipitation is more likely to be rain instead of snowfall, affecting snowpack and the slow release of water in drier and hotter summer months.

Temperature change has an impact on precipitation rates. In subtropical areas, monsoon rains will be heavier. There will also be more heat waves in summer and fewer prolonged cold periods in winter. Frost-free growing seasons at northern latitudes will be enhanced, but increased flooding in winter and drought in summer will negatively affect crop growth.

2. *What Are Some Mitigation and Adaptation Sound Practices?*

There are a range of mitigation and adaptation sound practices for temperature changes due to climate change. These include urban greenery projects in Seattle and Tokyo with rooftop gardens to reduce the impact of urban heat island effect, and improved building design and insulation in Albuquerque and Seattle (King County). See Section 05 for sound practice examples.

F/ WHAT ABOUT PRECIPITATION?

Increasing temperatures tend to increase evaporation, which leads to more precipitation.³⁰ As average global temperatures have risen, average global precipitation has also increased. According to the IPCC, the following precipitation trends have been observed:

- Precipitation has generally increased over land north of 30°N from 1900–2005, but has mostly declined over the tropics since the 1970s. Globally there has been no statistically significant overall trend in precipitation over the past century, although trends have varied widely by region and over time;
- It has become significantly wetter in eastern parts of North and South America, northern Europe, and northern and central Asia, but drier in the Sahel, the Mediterranean, southern Africa, and parts of southern Asia;
- Changes in precipitation and evaporation over the oceans are suggested by decrease in salinity of mid- and high-latitude waters (implying more precipitation), along with increased salinity in low-latitude waters (implying less precipitation and/or more evaporation); and
- There has been an increase in the number of heavy precipitation events over many areas during the past century, as well as an increase since the 1970s in the prevalence of droughts—especially in the tropics and subtropics.

1. *What Are the Effects and Impacts?*

Annual mean precipitation is expected to increase about 14 percent in East Asia. However, the precipitation is not distributed evenly across the Region. Present arid and semiarid regions are expected to become drier, and wet regions will become wetter.³¹ Thus, a more pronounced water resource shortage in the dry regions is expected, while increased precipitation in temperate and tropical Asia during the summer monsoon season will likely cause more frequent and severe floods and impact water supply to urban areas. The temperature changes are also expected to lead to increased losses of water through evaporation, reducing runoff and soil moisture in many areas.

2. *What Are Some Mitigation and Adaptation Sound Practices?*

There are many mitigation and adaptation sound practices for precipitation changes due to climate change. London and Venice are redesigning their urban stormwater drainage system, giving consideration to the change in frequency and intensification of rainfall. Other urban areas, Tokyo for example, are designing urban holding ponds under roads and parks to temporarily hold runoff water to avoid flash floods. Jakarta has recently initiated a program to construct a major stormwater drainage canal system known as the East Canal to provide adequate drainage to the eastern half of the city. Physical protection from typhoons and rising seawater levels is provided by Vietnam's extensive system of dikes—5,000 kilometers of river dikes and 3,000 kilometers of sea dikes. Dikes and levees have existed for over 1,000 years. Local government remains responsible for sea-dike protection. In the past, there was an extensive system of labor contributions for building and maintaining dikes, but this has increasingly been replaced by a system of hired labor and local taxes.

G/ WHAT ABOUT RESILIENCE?

The concept of resilience is central to the understanding of urban area vulnerability. Resilience is the capacity of a community or society to adapt when exposed to a hazard. It does this by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. A resilient society can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added human capacity to anticipate and plan for the future. Humans depend on resilience for survival. A resilient city is one that is able to sustain itself through its systems by dealing with issues and events that threaten, damage, or try to destroy it.

There are three defining characteristics of resilience in human-ecological systems: (a) the amount of disturbance a society can absorb and still remain within the state of the domain of attraction; (b) the degree to which the society is capable of self-organization or adjustment; and (c) the degree to which the society can build and increase the capacity for learning and adaptation.³²

Resilience varies greatly from household to household even in one locality. It is determined by two measures of peoples' livelihoods: (a) the assets they possess and (b) the services provided by external infrastructure and institutions. Strategies to strengthen the resilience of communities, and especially poor communities, should be based on the most effective combination of these two measures determined by local needs and capabilities. Assets include the amount and quality of knowledge



and labor available to the household, the physical and financial capital they possess, their social relations, and their access to natural resources. External services include those provided by flood control, coastal protection and other infrastructure, transport and communications, access to credit and financial systems, access to markets, and emergency relief systems. Resilience is greatly influenced by the quality of urban governance and the level of infrastructure and services provided by the government.

Resilience can be risk-specific: take, for example, the existence of cyclone and tsunami shelters. Strategies to enhance such specific resilience are an important measure of adaptation, and they tend to take place where the severity of the risk can clearly be identified and the investments in specific adaptations shown to be worthwhile. Resilience can also be general: the ability to withstand the impacts of shocks and trends that disrupt lives and livelihoods. Examples of this are the overall health or economic status of households, the diversity of livelihood sources, access to savings or credit, and the existence of strong social networks.³³

The resilience of societies in urban areas depends largely on underlying, slowly changing variables such as climate, land use, nutrient stocks, human values, and policies. Resilience of societies in urban areas can be degraded by a variety of factors including:

▲ *A resilient city must have strong infrastructure, policy, and human resource response capacities to avert potential impacts of natural hazards.*

- Deterioration of air, water, and food quality due to increase in pollution;
- Inflexible, closed institutions that do not adequately respond to the needs of society;
- Perverse subsidies that encourage unsustainable use of resources, or concentrate the resources in a small section of the society; and
- A focus on production and increased efficiencies that do not internalize the costs on the environment.

In most urban areas of East Asia, targeting improvements to general resilience is likely to be most effective, since demonstrating investments in reducing the threat of specific but unpredictable risks (such as possible changes to future climate in specific places) is difficult and since the households and communities face multiple vulnerabilities, including those due to the risk of natural disasters.

For cities, resilience is enhanced by knowledge of risks and tools and resources available to confront threats and build on opportunities.

1. **How Is Resilience Enhanced?**

Natural systems and societies are inherently resilient; but just as their capacity to cope with disturbance can be degraded, so can it be enhanced. The key to resilience in social-ecological systems is diversity. When the management of a resource or facility is shared by a diverse group of stakeholders (e.g., communities with varying economic conditions, government, or business community), decision making is better informed and more options exist for testing policies.

For cities, resilience is enhanced by knowledge of risks and tools and resources available to confront threats and build on opportunities.³⁴ The resilience of cities also increases by enhancing their autonomy and their governance system that rely on active collaboration between the different stakeholders. The resilience of urban areas is also greatly enhanced by disaster-resistant infrastructure. Ex-ante planning and infrastructure design to account for expected climatic and natural disaster occurrences can increase resilience, as can retrofitting existing infrastructure to increase its capacity to withstand such events.

2. **Are There Sound Practices?**

There are many sound practices for enhancing resilience. Any effort toward sustainable development of urban areas inherently enhances society's resilience. City development plans, which are based on social equity and which provide growth opportunities to the disadvantaged, improve coping capacity and thereby enhance their resilience.

Community-based disaster risk management programs improve the capacity of local people to respond to disasters. All such efforts—such as those being implemented in Tokyo, Jakarta, Singapore, Seattle, and other cities—improve the capacity of the first responders after any disaster and enhance the confidence of the society to face unexpected events.

H/ WHAT ABOUT EXTREME EVENTS?

Extreme climate-related events are those that deviate heavily from the norm.³⁵ Examples of extreme hydro-meteorological events include heat and cold waves, extreme precipitation episodes, exceptional storm surges, floods, and droughts. Climate change may cause intensification of these extreme events as well as increase their frequency of occurrence.³⁶

The use of “extreme event” is not associated with rare natural disasters even though their impact may be extremely destructive. Such events are more commonly categorized as “low probability” events. The frequency of occurrence of these events is not related to climate change.

1. What Are the Effects and Impacts?

The assessment of possible impacts due to change in extreme weather and climate events by the mid- to late 21st century indicates very severe adverse consequences for human health, settlements, and environment. The impact and consequences are likely to decrease the quality of life severely and result in major societal stress. Table 2.5 shows some of the major impacts of climate change due to changes in extreme weather events; the most important impacts are expected on water resources, human health and settlements.

Projected change	Examples of major projected impacts		
	Water resources	Human health/mortality	Industry/settlement/society
Warmer/fewer cold days/nights; warmer/more hot days/nights over most land areas	Effects on water resources relying on snow melt	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced effects of snow, ice, etc,
Warm spells/heat waves; frequency increases over most land areas	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality	Reduction in quality of life for people in warm areas without air conditioning; impacts on elderly and very young; reduced thermoelectric power production efficiency
Heavy precipitation events; frequency increases over most areas	Adverse effects on quality of surface and groundwater; contamination of water supply	Increased risk of deaths, injuries, infectious diseases, allergies, and dermatitis	Disruption of settlements, commerce, transport, and societies due to landslides, subsidence, or flooding; pressures on urban and rural infrastructures
Area affected by drought increases	More widespread water stress	Increased risk of food and water shortage and wildfires; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potentials for population migration
Number of intense tropical cyclone activity increases	Power outages cause disruption of public water supply	Increased risk of deaths, injuries, water- and foodborne diseases	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers

TABLE 2.5/ Examples of possible impacts of climate change

Source: IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC: Cambridge University Press, 2007).

TABLE 2.5/ (cont.)

Projected change	Examples of major projected impacts		
	Water resources	Human health/mortality	Industry/settlement/society
Incidence of extreme high sea-level increases	Decreased freshwater availability due to saltwater intrusion	Increase in deaths by drowning in floods; increase in migration-related health effects	Costs of coastal protection versus costs of land-use relocation; also see tropical cyclone activity above

The impacts of climate change with specific reference to the functional departments of urban areas are described in Table 2.6, where key climate change impacts and specific possible effects at local level are listed, sorted by competent city department.

TABLE 2.6/ Examples of specific impacts of climate change to functional units in urban areas

Source: Adapted and interpreted from the New Zealand Ministry of the Environment, 2008, <http://www.mfe.govt.nz/>

Department and its function	Affected assets or sectors	Key climate influence	Possible effects
Environment: Water supply and irrigation	Infrastructure	Reduced rainfall, extreme events, and increased temperature	Reduced security of supply (depending on water source); Contamination of water supply
Environment: Wastewater	Infrastructure	Increased rainfall	More intense rainfall (extreme events) will cause more inflow and infiltration into wastewater network; Wet weather overflow events will increase in frequency and volume; Longer dry spells will increase the likelihood of blockages and related dry weather overflows
Emergency and/or environment: Stormwater	Reticulation Stop banks	Increased rainfall Sea-level rise	Increased frequency and/or volume of system flooding; Increased peak flows in streams and related erosion; Groundwater level changes; Saltwater intrusion in coastal zones; Changing flood plains and greater likelihood of damage to properties and infrastructure
Transport infrastructure (including roads)	Transport Infrastructure	Extreme rainfall events, extreme winds	Disruption due to flooding, landslides, fallen trees and lines; Direct effects of wind exposure on heavy vehicles
Planning/policy development	Industrial settlements Expansion of urban areas Infrastructure Planning	All	Inappropriate location of urban expansion areas; Inadequate or inappropriate infrastructure, costly retrofitting of systems



TABLE 2.6/ (cont.)

Department and its function	Affected assets or sectors	Key climate influence	Possible effects
Environment and/or Parks and Recreation	Land use Land management	Changes in rainfall, wind, and temperature	Enhanced erosion; changes in type/distribution of pest species; increase fire risk; reduction in water availability for irrigation; changes in appropriate land use; changes in evapo-transpiration
Environment: Water care	Management of watercourses/lakes/wetlands	Changes in rainfall and temperature	More variation in water volumes possible; reduced water quality; sedimentation and weed growth; changes in type/distribution of pest species
Environment and/or Emergency: Coastal management	Infrastructure Management of coastal development	Temperature changes leading to sea-level changes Extreme storm events	Coastal erosion and flooding; disruption in roads, communications; loss of private property and community assets; effects on water quality
Civil defense and emergency management	Emergency planning and response, and recovery operations	Extreme events	Greater risks to public safety, and resources needed to manage flood, rural fire, landslip, and storm events
Environmental and Health: Bio-security	Pest management	Temperature and rainfall changes	Changes in range of pest species
Open space and community facilities management	Planning and management of parks, playing fields and urban open spaces	Temperature and rainfall changes Extreme wind and rainfall events	Changes/reduction in water availability; changes in biodiversity; changes in type/distribution of pest species; groundwater changes; saltwater intrusion in coastal zones; Need for more shelter in urban spaces
Transport	Management of public transport Provision of footpaths, cycle ways etc.	Changes in temperatures, wind and rainfall	Changed maintenance needs for public transport (road, rail) infrastructure; disruption due to extreme events

2. What Are Some Sound Practices?

Actions toward adaptation and mitigation, specifically focused on extreme events, are difficult because of the uncertainty inherent in their assessments. However, there are sound practices in mitigation and adaptation as evidenced by those illustrative sound practices found in the City Profiles (in Section 05 and on the CD-ROM) and other urban areas. Many of these have been planned from hazard management considerations without taking into account the root cause of more frequent extreme events. Some mitigation measures include more aggressive vector control, improvement of hydro-meteorological disaster warning and response system, heat-wave warning system, water conservation plans, and community preparedness, among others.



▲ *Just as climate-resilient infrastructure begins with laying a solid foundation, so, too, does an overall disaster risk management system.*

At this stage in the Primer, it would be appropriate to ask these questions:

- How prepared are your city officials and citizens to deal with an extreme event?
- Do the city officials and citizens know their roles and responsibilities?
- Have the city officials and citizens practiced the roles to become familiar with directions and routines?
- Are there backup and support groups identified to engage as needed in the mitigation and adaptation initiatives to be carried out?
- How do you apply the lessons learned from others' experiences so that your city is better prepared for the next extreme event that happens?



SECTION

03



Assessment Exercise: Discovery of a “Hot Spot”

Section 03 engages city officials in an assessment exercise to identify the city’s human and built environment characteristics, potential impacts of climate change, and natural or other hazards. Beyond that, the assessment will also identify local government prerogatives and authorities that would allow it to take action in dealing with potential climate change impacts and natural hazards.

The ultimate determination from the assessment is to identify main vulnerable and at-risk areas. This knowledge is then critical for defining priority actions that move (or “cool down”) the city from becoming a Hot Spot. Some contributing attributes that result in a city becoming a Hot Spot include the following:

- Moderate to high level of one or more natural hazards.
- Medium or high observed vulnerability in past disasters.
- Moderate to high sectoral vulnerability of climate change.
- Poor or nonexistent urban development plan or growth plan.
- Poor compliance with urban development plan or growth plan.
- Poor quality of building stock.
- High population density.
- Medium to large population or high decadal growth rate or high population density in case of low population.
- Medium or high slum density or large proportion of informal population.
- No comprehensive disaster response system.
- Economic and/or political significance in regional or national context.

The exercise requires completing a City Typology and Risk Characterization Matrix. The assessment is not a quantitative tool for ranking cities nor is it intended to be a scientifically rigorous assessment. It is intended to give the following results:

OBJECTIVES OF SECTION 03:

- Identify the interrelationship between governance structure, urban characteristics, disaster risk, and climate change impacts.
- Use knowledge of risks of various hazards to determine the composite risk of the city following a suggested Hot Spot identification exercise.

OUTCOMES OF SECTION 03:

- Identify the role of a Climate Change Team to mainstream the interrelationship between governance structure, urban characteristics, disaster risk, and climate change impacts.
- Become familiar with typology and the risk characterization matrix from which to evaluate the disaster risk and climate change impact and determine whether the city is a Hot Spot.

- Identify major problem areas for climate change impact and disaster risk management as a step toward identifying priorities for action;
- Generate awareness among local government officials and other stakeholders on the important contributors to climate change and disaster risk management;
- Assist the local government and other stakeholders to intuitively establish the link between climate change impact, disaster risk management, and urban governance; and
- Develop programs using the examples of sound practices from other cities (Section 05);
- Benchmark progress by filling out the matrix periodically.

For several cities, prior assessment of disaster risk or climate change impact may already be available. All such available information should be used in the exercise to establish the city's profile. For many questions, rigorous scientific information or prior assessment reports may not be available. For these questions, the exercise provides an opportunity to look back over several decades (the Primer recommends 50 years) to document and record events, trends, and cycles for determination of the query responses. Guidance is provided in the exercise to help differentiate annual events (such as monsoon flooding) from infrequent or episodic events (such as earthquakes) for response, preparedness, mitigation, and adaptation with regard to frequency and impact.

This exercise supports the idea of a local government establishing a working relationship with scientific institutes or technical bodies with expertise in natural hazard and climate change knowledge to advise on the impacts and management strategies to respond to climate change.

A/ COMPLETING THE CITY TYPOLOGY AND RISK CHARACTERIZATION MATRIX

The City Typology and Risk Characterization Matrix [see Tables 3.1(a)–(f)] is completed with information and data typically available within local government, and its preparation is an important step to engage various city departments and other stakeholders in climate change programs.

1. Select Climate Change Team

It is recommended that the city government identify a *City Climate Change Team* to prepare the Matrix. Depending on the city's ongoing activities in climate change impacts and disaster risk management, the Climate Change Team may not necessarily be a new team; it may include the expansion of scope of responsibility of an existing team such as the Disaster Risk Management Team. The *team head* should be an officer with sufficient authority to enable the team to implement the recommendations in the policies and programs of various departments of the government. The *team members* should represent those departments that deal with environment, planning, construction, transportation, and infrastructure, as well as other departments that impact climate change. The cities are also encouraged to include other stakeholders from the scientific and technical institutions and from civil society. The team can form the nucleus for continuing activities related to climate change impacts and disaster risk management after completing the assessment exercise. The selection of a City Climate Change Team can also be used to facilitate ownership of different programs by the line departments by ensuring their participation.



2. Hold Series of Workshops

It is recommended that a series of workshops be held that comprise a range of city stakeholders to discuss current situations and reach consensus on the assessment. The purpose of the initial workshop would be to ensure that consensus is built in terms of priorities, usable data, and other pertinent issues. As part of the workshop planning, key resource documents should be collected and provided to help in completing the City Typology and Risk Characterization Matrix. These workshops will also help officials and other participants to understand the importance of the City Information Base discussed in the Section 04.

▲ *Recognizing a city's risks and vulnerabilities is the first step to action.*

3. Complete the Matrix

Once the climate change team feels it has had proper discussions and collected adequate background material, it should complete the City Typology and Risk Characterization Matrix. Designed to give an overview of all important issues and activities that could affect the city, the City Typology and Risk Characterization Matrix is divided into 11 categories of attributes (A through K), in six main areas:

- City description (A-B)
- Governance and management (C-E)
- Built environment (F)
- Political and economic impacts (G-H)
- Natural hazards (I-J)
- Climate change impacts (K)

The Matrix has been divided into discrete tables for easier review and completion. Preceding each table is a detailed description of each category that will help in identifying the information requested for completing the Matrix.

City Description

Category A identifies the geographic location of the city. This helps in identification of impacts of climate change and the likely natural hazards that are of concern to the city. Section 02 of the Primer can help in determining how climate change impacts and disaster risks management are linked to city geography, (e.g., coastal cities and sea-level rise). See Table 3.1(a) for categories A and B.

Category B identifies the size and main characteristics of the city area and population. Resident population (i.e., night population), floating population (i.e., migrant day-workers), density, and growth rate are important indicators of the concentration of problems and their rate of increase over time. In general, larger, denser, or rapidly growing cities have higher vulnerability to climate change impacts and disaster risk. Moreover, if not properly accounted for in disaster preparation and response plans, the floating population enhances the risks and vulnerabilities of a city.³⁷ Where large numbers of migrants cannot be fully integrated into the permanent urban population and formal housing settlements, increases in informal settlements and pressure on the city's infrastructures is likely, consequently making the city even more vulnerable to the impacts of climate change and natural hazards. Moreover the larger the area a city occupies and the more dense a city is also impact the resources required to adequately protect the population against climatic events and natural hazards.

TABLE 3.1(a)/
Typology and Risk
Characterization Matrix
**City description and
size characteristics**

A. City description	
1. City location	
a. In a coastal area? (Y or N)	
b. On or near mountain area? (Y or N)	
c. On inland plain? (Y or N)	
d. On inland plateau? (Y or N)	
e. Near or on a river(s)? (Y or N)	
f. Near earthquake fault lines? (Y or N)	
B. Size characteristics of city	
1. Resident population (VH, H, M, or L) VH = Greater than 10 million H = 2 million to 10 million M = 0.5 million to 2 million L = up to 0.5 million	
2. Population growth during last 10 years (H, M, or L) H = Greater than 10% M = Between 2% to 10% L = Less than 2%	
3. Floating population (VH, H, M, or L) VH = Greater than 30% of resident population H = Between 20%–30% of resident population M = Between 10%–20% of resident population L = Less than 10% of resident population	
4. Area in square kilometers (km ²)	
5. Maximum population density (day or night) (H, M, or L) H = Greater than 2,000 persons per km ² M = Between 1,000 to 2000 persons per km ² L = Less than 1,000 persons per km ²	

Category C relates to governance structure and hazard management. Whether by appointment or by election,³⁸ excessively short terms in the government office may inhibit long-term planning. Appointed governments should prioritize stakeholder consultation and engagement to counter any misperceptions that they are not accountable to an electorate; stakeholder consultation is, of course, as important for an elected government. The existence of departments for disaster risk and climate change impact management indirectly verifies the level of city preparedness. If disaster risks and climate change impacts are managed by the same department, chances to develop linked plans and programs increase. The existence of disaster risk management and climate change departments at provincial and national levels is also an important indicator of the level of their integration with other departments of the local government. See Table 3.1(b) for categories D, E, and F.

Category D establishes the responsibilities for disaster risk management and climate change management. Responsibilities are clearly identified when someone is appointed to a specific activity (related to climate change and disaster risk management) and this appointment is well communicated and known by other departments. This exercise also helps to establish the level of decentralization depending on whether the city has an established system to contract for services.

Category E focuses on the financial resources of the city. Cities with a larger budget and those with significant financial autonomy (e.g., local taxes, levies, and access to domestic markets) will find implementing new climate change programs easier. The total budget should be viewed in light of actual needs for climate change and disaster management programs. Cities with large budgets may have even larger needs, and conducting this assessment up front will provide a clearer picture as to the resources that need to be raised.

Governance and Management

C. Governance structure as related to disaster risk management	
1. Appointed head of government? (Y or N)	
a. Term of assignment? (Years)	
2. Elected head of government? (Y or N)	
a. Term of elected officials? (Years)	
3. Local government office structure: Does it have...	
a. Disaster risk management department? (Y or N)	
b. Environment, sustainability or climate change department? (Y or N)	
c. Are (a) and (b) in the same department? (Y or N)	
4. Other government office structure (state, national): Does it have...	
a. Disaster risk management department? (Y or N)	
b. Environment, sustainability, or climate change department? (Y or N)	
c. Are (a) and (b) in the same department? (Y or N)	
D. City management on climate change and disaster risk management	
1. Responsibilities clearly specified? (Y or N)	
2. Responsibility for climate change management established? (Y or N)	
3. Responsibility for disaster risk management established? (Y or N)	
4. Authority to contract for services? (Y or N)	
E. Financial resources	
1. Total budget	
2. From local taxes and levies (% of total)	

TABLE 3.1(b)/
Typology and Risk
Characterization Matrix

**Governance
structure, city
management, and
financial resources**

TABLE 3.1(b)/ (cont.)

E. Financial resources	
3. From state and national government grants & devolutions (%)	
4. From domestic market—bonds & loans (%)	
5. From international market (%)	
6. From external or multilateral lending agencies (%)	

Built Environment

Category F relates to the city's built environment. This information is useful for establishing the physical vulnerabilities of the city. Existing programming and planning capabilities are inferred by verifying the presence of master plans and urban development plans. The presence of building codes and the level of compliance is a good proxy for regulating capacity in this field, which may be upgraded to include climate change impact and additional disaster risk management measures. High proportions of informal settlements are likely to indicate higher vulnerability of the city. Good insight comes from the level of dispersion of informal population: Concentrated informal settlements could further increase the city's vulnerability and risks to natural hazards. Older tenements and historical structures are likely to be highly vulnerable, and the proportion of total population in these buildings is a useful indicator of the city's risk profile. Information on observed vulnerability (in terms of extent of disruption of a building's functionality) during past disasters acts as an indication of structural vulnerability. In general, for new and formal settlements, vulnerability can be assigned based on the quality of building codes and the city's compliance level. If more than 5 percent of such buildings are vulnerable, vulnerability can be assigned as high. Medium vulnerability of new and formal buildings implies that 1 to 5 percent of buildings are vulnerable, while low vulnerability implies less than 1 percent of vulnerable buildings. The corresponding ranges for informal building types, in terms of percentage that are vulnerable, are as follows: low, less than 5 percent; medium, between 5 percent and 15 percent; and high, greater than 15 percent. The same percentages are given for historic buildings, which are already more vulnerable and often more valuable. See Table 3.1(c) for category F.

TABLE 3.1(c)/
Typology and Risk
Characterization Matrix
Built environment

F. Built environment	
1. Does the city have urban growth Master Plans? (Y or N)	
2. Does the city have urban development plans and land-use plans? (Y or N)	
a. Population in authorized development? (% of total)	
b. Population in informal colonies? (% of total)	
c. Population density of informal colonies? (H, M, or L)	
H = Population of informal colonies >20% of total	
M = Population of informal colonies <20% but >10% of total	
L = Population of informal colonies <10% of total	
d. Population in old tenements and historical development? (% of total or H, M, or L using ratings in 2c)	
3. Does the city have building codes? (Y or N)	
a. Level of compliance? (% compliant buildings)	
4. Observed vulnerability of buildings in past natural disasters (extent of disruption of building functionality)	
a. Informal buildings (H, M, or L)	
H = Greater than 15% of informal buildings highly vulnerable	



F. Built environment	
M = Between 5% and 15% of informal buildings highly vulnerable	
L = Less than 5% of informal buildings highly vulnerable	
b. Historic buildings (H, M, or L)	
c. New & formal developments (H, M, or L)	
H = Greater than 5% of new & formally developed buildings highly vulnerable	
M = Between 1% and 5% of new & formally developed buildings highly vulnerable	
L = Less than 1% of new & formally developed buildings highly vulnerable	

TABLE 3.1(c)/ (cont.)

Category G relates to the political impact of a disaster affecting some cities. Political impact can be high if the city is an administrative center, a financial and economic pole for the area, or an important service provider to the area. These cities should be identified as “hotter” Hot Spots on the basis of the impact of a disaster on these activities and capacities. See Table 3.1(d) for categories G and H.

Category H establishes the impact of disasters on the most relevant urban economic activities of the city. The word “major” means that those specific sectors are present in the city and account for at least 10 percent of local employment or at least 15 percent of income generation, each. A city with high economic significance is generally a “hotter” Hot Spot due to the widespread indirect adverse consequences of disasters or adverse climate change impacts affecting the city.

Political and Economic Impacts

G. Political impact of disasters	
1. Is the city a national/provincial capital or where a large number of decision-makers live? (Y or N)	
2. Is impact of disaster in the city likely to influence political activity in areas far away from affected regions? (Y or N)	
H. Economic impact of disasters	
1. Is the city a major center of economic activity in regional or national context? (Y or N)	
2. Do the following sectors have major activity in the city?	
a. Industrial sector? (Y or N)	
b. Services sector? (Y or N)	
c. Financial sector? (Y or N)	
d. Tourism and hospitality sectors? (Y or N)	

TABLE 3.1(d)/

Typology and Risk Characterization Matrix

Political and economic impacts

Category I assesses the threat of natural hazards. For most hazards, the information will be available from building regulations and from the past meteorological records (approximately for last 50 years). Seismic, tsunami, and volcanic hazards are very important since they occur after long intervals and may not have occurred during the last 50 years. These hazards should be considered in case they are identified as a specific hazard for the city in its master plan or in building code specifications. These hazards, if present, must be considered for all disaster management plans and in identification of the city as a Hot Spot since their occurrences often result in significant casualties and loss of property. The threat of other hazards is a useful indicator of their recurrence rate since climate change is likely to increase the frequency of these hazards.

Natural Hazards

Category J relates to the disaster response system and existence of a city's emergency response plan. It also assesses if the plan is comprehensive (such as with detailed plans and standard operating procedures for the most important hazards, and involving stakeholders other than the government), regularly practiced, and regularly updated so that the plan can be effective after a disaster occurs.

TABLE 3.1(e)/
Typology and Risk
Characterization Matrix

**Hazards and a
disaster response
system**

I. Threat of natural hazards	
1. Earthquake? (Y or N)	
2. Wind storm? (Y or N)	
3. River flood? (Y or N)	
4. Flash rainwater flood or extreme precipitation? (Y or N)	
5. Tsunami? (Y or N)	
6. Drought? (Y or N)	
7. Volcano? (Y or N)	
8. Landslide? (Y or N)	
9. Storm surge? (Y or N)	
10. Extreme temperature? (Y or N)	
J. Disaster response system	
1. Does a disaster response system exist in the city? (Y or N)	
2. Is the response system comprehensive and equipped for all natural hazards specified? (Y or N)	
3. Is the disaster response system regularly practiced? (Y or N)	
4. Is the disaster response system regularly updated? (Y or N)	

Climate Change Impacts

Category K relates to climate change impact. *Does the city know what the impacts of climate change are?* To know means that the city has enough background and knowledge resources to address actions and measures in the field, including the impact on several urban sectors. The impact may be known from detailed scientific investigations or from empirical data and field observations. Moreover, the matrix response relies on the existence of a climate change policy (and/or a strategy) and of climate change programs, specifically addressing the issues of mitigation, adaptation, and resilience as discussed in Section 02. This information will also help prepare for climate change events by climate-proofing certain sectors (e.g. beach tourism to have sea walls and clear evacuation plans) or by diversifying a city's economic base. Table 3.1(f) reflects the existence or presence of these climate change programs; more details on disaster risk management preparedness will be reflected in Tables 3.2 and 3.3. If climate models are available at regional, local, and national levels, comparison and more effective scenario evaluation is possible, and climate change programs will then be developed consistently.

TABLE 3.1(f)/
Typology and Risk
Characterization Matrix

**Climate change
impacts**

K. Climate change impact	
1. Is the impact of climate change on the city known? (Y or N)	
2. Are the following sectors vulnerable to the consequences of climate change?	
a. Built environment? (Y or N)	
b. Cultural and religious heritage? (Y or N)	
c. Local business, industry, and economy? (Y or N)	

K. Climate change impact	
d. Energy generation and distribution system? (Y or N)	
e. Health-care facilities? (Y or N)	
f. Land use? (Y or N)	
g. Transportation system ? (Y or N)	
h. Parks and recreation areas? (Y or N)	
k. Tourism? (Y or N)	
3. Is climate change assessment based on local studies instead of regional/global models? (Y or N)	
4. Does the city have a climate change strategy (maybe as a component of national policy)? (Y or N)	
5. Does the city have climate change programs in place? (Y or N)	
6. If Yes, do the climate change programs consider:	
a. Mitigation? (Y or N)	
b. Adaptation? (Y or N)	
c. Resilience? (Y or N)	

TABLE 3.1(f)/ (cont.)

B/ ADDITIONAL TESTING FOR A HOT SPOT

A clearer link between climate change impacts and the city vulnerability assessment can be established by completing Table 3.2, in which cities evaluate the consequences of specific climate factors, such as temperature rise, precipitation change, and sea-level rise on the main sectors in their city.

Attribute matrix	Climate factor		
	Temperature rise	Precipitation change	Sea-level rise
Rate the level of vulnerability in each of the following areas.			
H = Very important consequences and priority for action			
M = Important and should be considered in city development plans			
L = Unimportant			
Built environment (H, M, or L)			
Cultural and religious heritage (H, M, or L)			
Local business, industry, and economy (H, M, or L)			
Energy generation and distribution system (H, M, or L)			
Health-care facilities (H, M, or L)			
Land use (H, M, or L)			
Transportation system (H, M, or L)			
Parks and recreation areas (H, M, or L)			
Social equity system (H, M, or L)			
Water management (H, M, or L)			
Tourism (H, M, or L)			

TABLE 3.2/ Vulnerability assessment for different consequences of climate change in urban areas

If the vulnerability to a specific climate impact in a sector is not known or poorly understood, the City Climate Change Team can refer to the information provided in Section 02 and can review the materials and downscaling methods listed in the Annex D Resource Guide. If the City Climate Change Team is able to define the most important threats by using Table 3.2, the team will better understand the extent to which the city is a Hot Spot and the factors that contribute to this determination, simply by the attributes rated at medium and high vulnerability levels. With this knowledge, the team can use Section 05 to build on it and gain insight from relevant international sound practices.

A benchmark evaluation of risks can also be helpful in motivating the city to understand where the main gaps and difficulties are in preparing for disasters and natural hazards. To establish a benchmark evaluation on Disaster Preparedness and Response in specific sectors for specific natural hazards, the city officials and their Climate Change Team should complete Table 3.3. The latter could be further specified and detailed by the team itself.

TABLE 3.3/
Preparedness and response to different natural hazards in urban sectors

Attribute matrix	Disaster preparedness and response			
	Industrial sector	Service sector	Financial sector	Tourism and hospitality sector
Define the level of preparedness for each event for each sector.				
H = High level of preparedness and readiness to respond to disaster and hazard				
M = Somewhat high level and the basic/key informants are present (i.e., a basic disaster management system is in place, but may not be comprehensive or consider specific hazards)				
L = Low (i.e., no disaster management system, no warning system, etc.)				
1. Earthquake (H, M, or L)				
2. Wind storm (H, M, or L)				
3. River flood (H, M, or L)				
4. Flash rainwater flood or extreme precipitation (H, M, or L)				
5. Tsunami (H, M, or L)				
6. Drought (H, M, or L)				
7. Volcano (H, M, or L)				
8. Landslide (H, M, or L)				
9. Storm surge (H, M, or L)				
10. Extreme temperature (H, M, or L)				

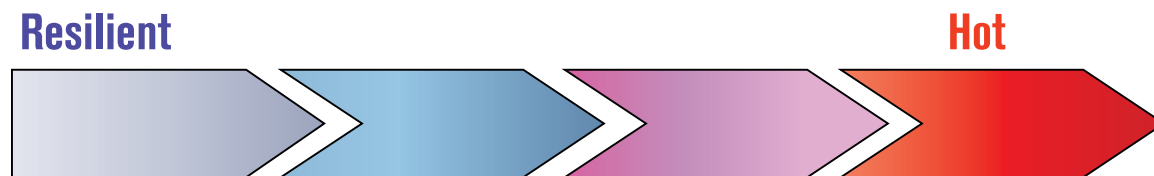
To fill out Table 3.2, experience from past disasters or information from global studies, such as those included in the IPCC reports or in UNISDR documents, should be used to assess the risks. The attributes are also intended to motivate the city to carry out this risk assessment based on local scientific models so that the impact is assessed with greater accuracy. Since mitigation measures are essential for better response to natural hazards, and resilience is essential to improve the capacity of a city to respond to any disaster, these factors are explicitly included in the Sound Practices Section for the reference of the City Climate Change Team. If these risks in the specific sectors are not known, the City Climate Change Team should refer to the information provided at Section 02 and/or the materials and downscaling methods from the Annex D Resource Guide.

C/ IS YOUR CITY A HOT SPOT?

Being a Hot Spot means that the city has a high level of vulnerability to climate change impacts (at least in some sectors, activities, and areas) and is at high risk of being affected by natural disasters.³⁹ After completing the matrices (Tables 3.1, 3.2, and 3.3), the Climate Change Team should be able to determine whether some conditions (Categories A–H, Table 3.1) and threats (Categories I–K, Table 3.1) are present in the city. To define whether these conditions and threats make the city a Hot Spot, some attributes should be verified more in depth (Table 3.2 and 3.3).

Based on the completed City Typology and Risk Characterization Matrix and rating levels, the city government and Climate Change Team should determine their vulnerability assessment that leads to a Hot Spot characterization: the higher a city’s vulnerability, the “hotter” the city is as a Hot Spot (Figure 3.1).

FIGURE 3.1/ The climate change Hot Spot spectrum



The greater the number of adverse conditions that are satisfied (ratings of High and Medium and Yes responses), the “hotter” the city’s categorization is as a Hot Spot. Some conditions that determine a Hot Spot are considered static or given. Static conditions include the existing political structure, disasters history, and the city geography—conditions that are not influenced by city policies. All others can be influenced by the city policies. City policies on climate change and disaster risks management should focus on the elements that may be influenced.

The level of “hotness” can be used by the city to prioritize its activities and to motivate integration of development plans considering climate change impacts and disaster risk management. When cities take proactive actions to respond to disaster risk and climate change impacts, “cooling” the Hot Spot will be reflected in the City Typology and Risk Characterization Matrix since it will reduce the number of adverse conditions.

The evaluation of a city as a Hot Spot from climate change impacts and disaster risk management considerations [Tables 3.1(e) and (f), Categories I–K] can be also assessed based on indicators specified in Table 3.4, as proposed by UNISDR. Each indicator needs to be examined in the city context to determine its relevance and importance when evaluating a city as a Hot Spot. The city officials and the Climate Change Team could use the recommended indicators as a checklist to evaluate their level of preparedness and the ability of their city climate change impact and disaster management systems to reduce vulnerability and risks.

City policies on climate change and disaster risks management should focus on the influentiable elements.

TABLE 3.4/
Recommended
indicators for
preparedness

Priority for action	Recommended Indicators
1. Ensure that climate change impact and disaster risk management is a local priority with a strong institutional basis for implementation.	<ul style="list-style-type: none"> (a) Institutional and legal frameworks for climate change impacts and/or disaster risk management exist with decentralized responsibilities and capacities at all levels. (b) Dedicated and adequate resources are available to implement climate change impacts and disaster risk management plans at all administrative levels. (c) Community participation and decentralization is ensured through the delegation of authority and resources to local levels.
2. Identify, assess, and monitor disaster risks and enhance early warning.	<ul style="list-style-type: none"> (a) Local risk assessments based on hazard data and vulnerability information are available and include risk assessments for key sectors. (b) Systems are in place to monitor, archive, and disseminate data on key hazards and vulnerabilities. (c) Early warning systems are in place for all major hazards, with outreach to communities.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.	<ul style="list-style-type: none"> (a) Relevant information on disasters is available and accessible at all levels, to all stakeholders (through networks, development of information-sharing system, etc.). (b) School curricula, education material, and relevant training include risk reduction and recovery concepts and practices. (c) Research methods and tools for multirisk assessments and cost-benefit analysis at the city or regional level are developed and strengthened. (d) Public awareness strategy exists to stimulate a culture of disaster resilience, with outreach to urban and rural communities.
4. Reduce the underlying risk factors.	<ul style="list-style-type: none"> (a) Disaster risk management is an integral objective of climate change-related policies and plans, including for land use, natural resources management, and climate change adaptation. (b) Social development policies and plans are being implemented to reduce the vulnerability of populations most at risk. (c) Economic and productive sectoral policies and plans have been implemented to reduce the vulnerability of economic activities. (d) Planning and management of human settlements incorporate climate change impacts and disaster risk management elements, including enforcement of building codes. (e) Disaster risk management measures are integrated into postdisaster recovery and rehabilitation processes. (f) Procedures are in place to assess disaster risk impacts of all major development projects, especially infrastructure.
5. Strengthen disaster preparedness for effective response at all levels.	<ul style="list-style-type: none"> (a) Strong policy, technical, and institutional capabilities and mechanisms for disaster management, with a disaster risk reduction perspective, are in place. (b) Disaster preparedness plans and contingency plans are in place at all administrative levels, and regular training drills and rehearsals are held to test and develop disaster response programs. (c) Financial reserves and contingency mechanisms are in place to enable effective response and recovery when required. (d) Procedures are in place to exchange relevant information during disasters and to undertake postevent reviews.



The next section describes the **City Information Base**. This is another tool for the city to understand itself better in the context of disaster risk and climate change impact management. The availability of the City Information Base will enable more accurate assessment of the Hot Spot status using the Matrix. The Typology and Risk Characterization Matrix can therefore be considered as an exercise that is carried out at regular intervals to incorporate the most recent City Information Base.



SECTION

04



Information Exercise: Creating a City Information Base

A *City Information Base* will be the foundation of stakeholder consultation and community engagement in developing the policies and programs to address the city's climate change and disaster management priorities and programs. The City Climate Change Team, with participation of other stakeholders, should have completed the assessment in the Typology and Risk Characterization Matrix (Section 03) as a first step to creating a working information base.

Why have a City Information Base? An updated, working information base is key to sound urban management. It will explain the city context and the “why” behind the plans to mitigate and adapt to changing conditions, aggravated hazards, and more intense disasters.

In developing the City Information Base, it is important to link and merge climate change and disaster risk management issues and activities. The crossover influence through cause and effect helps to establish priorities and policies and will guide the preparation and implementation of structural and nonstructural programs through capital investment projects and outreach, training, and education initiatives.

A/ THE WORKBOOK

All information, maps, and related data that comprise the City Information Base should be gathered into a single document, a *Climate Change Impacts and Disaster Risk Management Workbook*. As information and maps are updated, the changes are reflected in the Workbook. The Workbook becomes the reference document for planning by the city and its communities. The Workbook is a useful record and tool of the process and results of addressing impacts and hazards that lead to policy and plan development and implementation.

OBJECTIVE OF SECTION 04:

- Review and consolidate the city's information base in a single Workbook as a record of the process and results of addressing impacts and hazards that lead to policy and plan development and implementation. The City Information Base contributes to development of the climate change impact and disaster risk management plans.

OUTCOMES OF SECTION 04:

- Identify and establish an information working group, as part of the Climate Change Team, that will prepare a City Information Base.
- The City Information Base will help structure the impact management plans, guide the city management structure, and coordinate and distribute responsibilities among various stakeholders.

B/ THE PARTICIPATORY PROCESS

The preparation of the Workbook is a participatory process, one that has been tested and validated. The Workbook is comprised of an initial set of annotated maps of key information and issues of the city/community. The following are recommended procedures for developing the Workbook:

- ***The city should empower a Working Group, an existing office or designated group, with responsibility to prepare*** the City Information Base as a joint process facilitated by the local government team which should include key city departments, the private sector, and civil society.
- ***The city officials should convene a workshop*** where the Working Group presents the structure of the Workbook. The content of the Workbook should include the suggested annotated maps (that follow in this section) and others that relate to city type, Hot Spot determination, and any particular context that characterizes the community.
- ***There should be an adequate period of time to address relevant issues.*** These discussions should be recorded or summarized for inclusion in the Workbook. Discussions might cover the identification of vulnerable populations; description of the built and natural environment of the community; identification of the economic base; future growth of the city/community; the institutional base of the city as well as information regarding the determination of evacuation routes, spatial development, available land, and land use; the development of tourist attractions and other economic activities; and the protection of natural resources, harbors, historic urban areas, and archeological sites.
- ***There should be a designated group to work on each map.*** Working with the city base map, the groups should make annotations for their specialized map. All groups would convene to present and discuss their findings. The materials prepared would also serve to inform outreach efforts to a broader population.
- ***The maintenance of the Workbook offers the city opportunities to bring its stakeholders together to identify and discuss results and problems of city management and growth, devise new and/or modify existing plans, and develop awareness of conditions that require attention.*** The development of the Workbook is a process to keep a current information base. The stakeholders include public entities and offices of local and national government, private sector groups, industry and commerce, civil society, non-governmental organizations (NGOs) and associations, and specialized interest groups. The local government facilitates the Workbook development process with stakeholders.

C/ THE ANNOTATED MAPS

The Workbook becomes the repository of the annotated maps and subsequent strategies and plans prepared to deal with climate change impacts and disaster risk management issues. The following annotated maps should be prepared and included in the Workbook and updated regularly:

1. City/Community Base Map

The City/Community Base Map is an annotated graphic representation of the layout of the city/community that records the natural and built environment, especially its land resources.

The following recommended information should be included in the map:

- City/community boundary;
- Roads;
- Infrastructure water supply, sanitation, and sewerage;
- Housing;
- Community buildings, such as schools, museums, hospitals, special interest structures, markets, churches, mosques, temples, other;
- Natural elements, such as mangroves, hills, rivers, plantations, other;
- Ports, stadiums, playing fields, marinas, airports, other; and
- Urbanized and vacant land and other land use designations.

▼ *Community involvement in the preparation of maps for the Workbook empowers participants and introduces greater accuracy into the process.*



2. City/Community Socio-Economic Profile Map

The city/community socio-economic profile map provides annotations on the population derived from local sources and census data presented in as disaggregated a manner as possible. This map will give data on household numbers, religion, age, gender, and occupation of the city/community inhabitants. Also included is pertinent data on vulnerable populations. Information on vulnerable populations is mapped with the location at the household level and is used to prepare vulnerable population evacuation guides, education assistance, and training plans.

The following recommended socioeconomic information should be included in the map:

- Economic activities, including industry, manufacturing, central business districts, hospitals, universities, ports, tourism attractions, small businesses and urban farming areas;
- Vulnerable populations, including the aged, children, invalids, women heads-of-household, ethnic minorities, others; and
- Support annotations, including population statistics of total population indicating male, female, children, and age group if available. Vulnerable populations are also to be identified and indicated.

3. City Hazard Profile Map

The city hazard profile map records potential hazard-affected areas and locates potential climate change impacts through the development of scenario planning. The annotations on maps should include hazard priorities listed in their order of importance. The priorities list serves as a guide for the next step of policy and action plan development. A disaster history is prepared to promote the idea of a written record to city/community management. It indicates areas affected by floods with high-water marks, landslides, fires, typhoons, and tsunamis, and their frequency. Episodic natural disasters (earthquakes and volcanic eruptions) and the areas most affected by them should also be recorded. The assembly of the multihazard map may show affected areas of overlap that can indicate complex issues such as health hazards and no-build areas. Maps should also use graphics to indicate climate change impacts scenarios that illustrate the potential impacts and disasters for planners and government officials to visualize the situation and plan accordingly. This information is critical to climate change and hazard mitigation and adaptation infrastructure investments and can be planned together to avoid duplication and waste.

The following recommended climate change impacts and hazards map information should be included in the map:

- Identification of areas vulnerable to natural hazards that include earthquakes, floods, storm surges, typhoons, sand and dust storms, tsunamis, others; and
- Climate change impacts scenarios that include sea-level rise, water management and supply issues, and extreme events.

4. The Future Growth Map

The Future Growth Map is based on an appreciation of the importance of addressing the future growth of green-built environments as part of the planning process for shelter and other land

The assembly of the multihazard map may show affected areas of overlap that can indicate complex issues such as health hazards and no-build areas.

uses, transportation, parks, and power users. The Future Growth Map presents a “vision” of the city indicating the type of investment, the amount and the location of capital requirements for sustainability and resilience, as well as annotations on the capacity-building efforts required to manage community facilities. Understanding how cities grow is important to developing resilient communities and to controlling the growth of their built environment. Of special interest is the mitigation and adaptation infrastructure to address climate change impacts and hazards management, such as sea walls, escape routes, raised walkways, canals, and landscape restoration. Other pertinent items that should be established are the limits to growth usually dictated by water supply and topographic constraints. It may be that a city decides to not issue permits for construction or access to water for which the resources are just not there.

It is necessary that future growth plans take into account land resources as well as the institutional responsibilities and capacity to deliver basic infrastructure and services. Identifying safe and secure land is particularly important to resilient growth. It strategically locates new shelter development and economic activities to avoid marginal locations such as flood plains, seismic areas, and unstable slopes.

The following recommended city/community future growth information should be included in the map:

- Available land for development and potential climate change impacts, especially flood plains and landslide-prone areas, steep slopes, and poor soils for development;
- Capital projects that the city/community identifies as priorities, especially those that will address climate change impacts and support the development of a resilient community; and
- Priority improvements identified in city/community consultations, especially those relating to retrofitting existing structures and historic urban areas, water supply, and flood and storm surge controls.

5. *City Institutional Map*

The City Institutional Map lays out in annotated charts and text the different players and offices engaged in and with local government. The map documents the roles and responsibilities of city offices and departments, state- and national-level offices that offer support, and private sector and civil society groups interested in working with the city and able to contribute to policy and program development, finance, and implementation.

The following recommended city institutional arrangements should be included in the map:

- City offices with responsibilities for climate change and disaster risk management, including Sustainability Offices, Housing Departments, Water and Sanitation Departments, Emergency Management Departments, Transportation Departments, Energy Offices, Finance Offices, among others;
- State Offices responsible for emergency management and “green” development, industrial parks, parks and recreation, historic conservation offices, and finance departments, among others;

- National Offices and Ministries responsible for emergency management, disaster risk management, urban development, among others;
- Private sector entities, chambers of commerce, industrial boards, among others; and
- Civil society organizations, international nongovernmental organizations, and academic/technical support institutions.

D/ THE FRAMEWORK

With the Workbook information evolving over time, the next steps are to apply the information to policy and action programs development. The City Information Base informs these next steps. Box 4.1 reviews the steps to development of a *Climate Change and Disaster Risk Management Framework*. The Framework identifies essential components of a larger process for cities to prepare and employ policies and strategies that deal with potential climate change impacts and disaster risk management issues in cities.

Box 4.1 Recommended steps toward developing a planning framework

- (a) Review and confirm the City Climate Change and Disaster Risk Management Team.
- (b) Review and discuss the Climate Change and Disaster Risk Management Workbook preparation/update.
- (c) Identify partnerships and the preparation of a Partnership Support Guide.
- (d) Discuss and develop specific climate change mitigation, adaptation, and disaster risk management plans through the plan development question sequence.
- (e) Discuss and prepare a program to document results of the climate change mitigation, adaptation, and disaster risk management prepared plans.
- (f) Identify start-up activities.

The Framework is aided by Priority Plan Development Questions (Box 4.2) to guide specific priority issues in development of the Framework. The Priority Plan Development Questions are a guide for defining the priority issues to be inserted in the plan. The answers to the questions will comprise the plan that is later detailed to define and specify the specific activities required to address the identified priority. Plan development is a critical step of the framework, one that presents a set of questions that are sequential and that guide the preparation of specific priority Climate Change and Disaster Risk Management Plans.

Box 4.2 Recommended priority plan development questions

The designated team answers the following questions as a guide to policy and plan development:

1. **What are climate change and/or disaster risk management priority actions?**
 - a. Identify the priority action for which the plan is to be developed.
 - b. Establish the improvement to be implemented.
 - c. Identify expected outcome of the priority action. Why are we doing this and what do we expect to be the results?

Box 4.2 (cont.)**2. What is the strategy?**

- a. For adaptation: Establish what can be done to adapt to the potential hazard before it becomes a disaster.
- b. For mitigation: Establish what can be done to lower the impact and reduce the vulnerabilities.
- c. For response: Establish what response plans, responsibilities, and activities are necessary to deal with an event.

3. What equipment is necessary?

- a. What equipment is required to address the impact for preparedness and mitigation initiatives
- b. What new technologies?
- c. What else?

4. What is the budget?

- a. Should there be capital requirements for Plan implementation, what sources are available and/or need to be created?
- b. Budgeting exercises are critical to Plan design. It is far better to set realistic financial limits and implement activities over time than to design plans without a realistic idea of the costs to plan implementation.

5. What is the necessary training?

- a. The capacity of cities and their communities to prepare and implement plans is always a question. Therefore plans of necessity need to consider capacity building as part of plan preparation and implementation.
- b. Once specific capacity-building and training needs are identified, sources of training support are to be identified from the Partnership Support Guide.

6. What practice?

- a. Climate Change and Disaster Risk Management Plan implementation and simulations are important elements and need to be built into plan activities.
- b. Planned and unannounced drills are to be scheduled by the pertinent office to identify issues in the plans, to identify what worked, and to correct what did not. One does not "fail" a drill. The drills and simulations are to be implemented with the idea of learning.

7. What is the designated office/entity for management of the Plan and what are its responsibilities?

- a. Each Climate Change and Disaster Risk Management Plan has responsibilities that different offices and entities will need to assume.
- b. Each committee will need written responsibilities and response plans as a record of what is to be done and by whom.

The climate change impact and disaster risk management plans needs to consider the city's priorities and the feasibility of initiating measures in the short, medium, or long term.

The above exercises and questions are a reference for future and more detailed work to prepare and implement priority plans. The climate change impact and disaster risk management plans should consider the city's priorities and the feasibility of initiating measures in the short, medium, or long term. In development of climate change emission improvements and disaster risk management initiatives, the timeframe is an important issue, one that responds to the planning capacity of a city, staff skills level to implement the plan, and resources available to finance the costs of any identified capital improvements.



Clear maps that show evacuation routes, such as this one in Thailand for tsunami warnings, are critical to minimizing casualties.

Section 05, **Sound Practice Examples of Adaptation and Mitigation**,

addresses some of the challenges that cities face and these demonstrate how sound practices have been effective.

The cities that have not yet started considering disaster risk management or climate change impact management can refer to the different organizational structures and institutional mechanisms for initiating their programs. Cities further along this process can use these sound practice examples for developing their programs based on the improvements determined through the assessment exercise.



SECTION

05



Sound Practice

Examples of Adaptation and Mitigation

Cities have only recently begun to define their own tools and measures to deal with climate change impacts and disaster risk management. Some cities know how to assess their risks and evaluate their vulnerabilities, and how to find proper technical skills among their employees and through local experts. Cities have also learned how to overcome financial resource bottlenecks, relying on additional financing from domestic markets, from innovative financial instruments, and from international donors.

Sound practices are processes, practices, measures, and systems identified in selected cities that performed well in particular conditions and are recognized as improving a city's performance and efficiency in the specific areas of climate change impact and disaster risk management. Several practices adopted by cities have been chosen as illustrative examples of actions taken and programmed in the field. All the selected practices are transferable, even if in different ways and following different timelines, and all of them were successful where implemented.

The cities being exemplified in this sound practices section have demonstrated that they make their own decisions on how to deal with climate change impacts and disaster risk management. The illustrative examples come from City Profiles that are more fully discussed on the CD-ROM. Cities featured on the CD-ROM are:

- Albuquerque, New Mexico, USA;
- Dongtan, China;
- Hanoi, Vietnam;
- Jakarta, Indonesia;
- London, England, UK;
- Milan, Italy;
- New York City, New York, USA;
- Makati City, Metro Manila, Philippines;
- Venice, Italy;

OBJECTIVE OF SECTION 05:

- Become familiar with adaptation and mitigation sound practices that are beneficial for reducing climate change impacts and enhancing disaster risk management.

OUTCOMES OF SECTION 05:

- Become familiar with supporting documents and resource information useful to Disaster Risk Management and Climate Change Impact Plan development efforts.
- Become familiar with specific examples that will help formulate the plan including project identification, financing, institutional arrangements, and implementation of identified structural and nonstructural training and capital investment programs.



- Rockville, Maryland, USA;
- Seattle/King County, Washington, USA;
- Singapore; and
- Tokyo, Japan.

These cities and their experiences have been chosen for their ability to illustrate specific measures, applicable even in other contexts, with mostly innovative and very successful stories. This is not intended to be an exhaustive representation of sound practices.

Other examples, not included in the City Profiles but described in Sound Practices, come from the following cities:

- Albay Province, Philippines,
- Bogota, Colombia;
- Dagupan City, Philippines;
- Nam Dinh Province, Vietnam;
- Navotas City, Philippines;
- Thua Thien Hue Province, Vietnam; and
- Vancouver, Canada.

Table 5.1 at the end of Section 05 sums up the sound practices in order of their short- (less than one year), medium- (more than one but less than three years), and long-term (more than three years) applicability, and identifies ownership and responsibilities in the municipalities.

SOUND PRACTICE 1/ ORGANIZATIONAL STRUCTURE AND INFORMATION BASE

The initial step for developing a climate change impact and disaster management risk plan is building a solid information base, just as in the first steps of the Primer. All information is pulled together from various sources (environment, crisis management, accounting, and others) through various means (interviews, meetings, archives, experts), and from various regions (broad-scale studies). The planning is participatory and requires team effort.

Seattle/King County, Washington, USA. This county developed a specific questionnaire that focused on sensitivity assessment (i.e., how climate change is likely to affect the natural and built environments); adaptation capacity assessment (i.e., ability of built, natural, and human systems associated with a given planning area to accommodate changes in climate with minimum disruption or additional cost); vulnerability assessment (i.e., susceptibility of a system to harm from climate change impacts); and cross-agency and cross-sector interaction assessment (i.e., level of cooperation, exchange of information and data). The county also proposes an effective strategy for maximizing limited means by pooling resources with neighboring local governments. This approach not only provides the benefit of cost sharing but also allows for developing and applying consistent information on projected climate change impacts through regional planning processes.

The initial step for developing a climate change impact and disaster management risk plan is building a solid information base.



New York City, New York, USA. New York City (NYC) has developed a comprehensive scientific study on downscaling the climate change impacts. Downscaling means taking a potential general impact and adjusting it to the specific city. The municipality worked with specific agencies in the area (Environmental Protection Agency, Federal Emergency Management Agency, U.S. Army Corp of Engineers), with academia (Columbia University), and with other research institutes National Aeronautic and Space Administration (NASA) to collect all the needed data, adjust available computer models, and run specific software to downscale the analysis to the metropolitan level.

SOUND PRACTICE 2/ INSTITUTIONAL MECHANISM

In the context of climate change, mainstreaming implies that awareness of climate impacts and associated measures to address these impacts are integrated into the existing and future policies and plans of cities. At the city level, mainstreaming shifts the responsibility for climate change and disaster management from individual councils, ministries, or agencies to all sectors of government, civil society, and private sector. However, to ensure mainstreaming does not lead to adaptation/mitigation efforts becoming fragmented, a coordinating mechanism such as a multistakeholder committee is generally required. Another important step is to map the stakeholders, then promote dialogue by the national government (focal points for climate change and disaster risk management) with donors, NGOs, and private sectors. It is fundamentally important to get a broad range of stakeholders, including civil society, sectoral departments, and senior policymakers, engaged in the dialogue to ensure a more coherent approach to mainstreaming, and therefore more effective implementation and sustainability.

Singapore. Since climate change actions cover many sectors of the economy and society, Singapore has developed its National Climate Change Strategy through a consultative, multistakeholder approach. The views of the stakeholders and the public at large were sought in developing Singapore's response to climate change. The leadership is provided by a ministerial committee on climate change chaired by the Deputy Prime Minister of Singapore. All the main departments and ministries are included in the ministerial panel. This ensures that the National Climate Change Strategy will have strong institutional support and that the policies will be accorded full importance by the government and other stakeholders. Since most programs that are developed involve several ministries and departments, Singapore has also established four subcommittees (buildings, households, industry, and transportation) and four working groups (electronics, silicon wafer fabrication, pharmaceuticals, and research and development) under the national committee.

New York City, New York, USA. Mayor Michael R. Bloomberg created the Office of Long-Term Planning and Sustainability. As part of the office's broad mandate to address housing, transportation, and other infrastructure needs over the next 25 years, it will coordinate the development of a climate adaptation strategy. Drawing on other city agencies, including the Department of Environmental Protection and the Department of Buildings, the new long-term planning office has met

Mainstreaming implies that awareness of climate impacts and associated measures to address these impacts are integrated into the existing and future policies and plans of cities.



with more than 100 advocacy organizations, conducted community meetings in each borough, and taken into account thousands of individual e-mail messages collected through its website. To define the climate adaptation strategy (action plan), both for mitigation and adaptation, the responsible office and consultant have developed a “stakeholder interactive approach” by building contacts with the Environmental Protection Agency, Region II; Federal Emergency Management Agency, Region II; U.S. Army Corps of Engineers; National Park Service; Gateway National Recreation Area; Port Authority of New York and New Jersey; NYC Department of Environmental Conservation; NYC Energy Research and Development Authority; NYC Department of Environmental Protection; NYC Department of Health; NYC Department of City Planning; NYC Department of Design and Construction; NYC Department of Parks and Recreation; Con Edison; Metropolitan Transit Authority; and the Regional Plan Association.

Makati City has set up strong institutional mechanisms for facilitating action on climate change and disaster risk management.



Makati City, Philippines. Makati City has set up strong institutional mechanisms for facilitating action on climate change and disaster risk management. The city has set up the Makati City Disaster Coordination Council (MCDCC) as the apex body for planning disaster risk management efforts in the city. The city has also set up the Makati City Environmental Protection Council (MCEPC) as the apex body for planning environmental and climate change management in the city. The MCDCC has representation of all relevant departments of the national and city governments, along with the MCEPC. Similarly, the MCEPC has representation of all relevant departments of the national and city governments, along with the MCDCC. The institutional structure of these two bodies facilitates coordinated planning and also ensures that the cross-cutting issues are fully dealt within the two councils.

Dagupan City, Philippines. Dagupan City has established a Technical Working Group from its City Disaster Coordinating Council to implement preparedness and mitigation activities and to address climate change. The Technical Working Group members include heads of all relevant city departments. Since the same committee looks after both disaster risk management and climate change management, the city has also made policy changes requiring all disaster risk management programs to include climate change adaptation into their programs.

Albay Province, Philippines. Albay Province has formed the Center for Initiatives and Research on Climate Adaptation (CIRCA) as a public-private partnership to help evolve the adaptation priorities in the province and assist in their implementation. All the relevant departments of the provincial and various local governments are under the umbrella of the Center. CIRCA also has participation from academic institutions and the corporate sector. In order to institutionalize adaptation programs in the government, the province has also categorized expenditure on adaptations as a mandatory expenditure item. The local villages, which are the most vulnerable in the province, are provided grants for disaster risk management and climate change adaptation programs.

SOUND PRACTICE 3/ OWNERSHIP BY LINE DEPARTMENTS

All the cities's climate change impact and disaster risk management stories are rooted in dedicated and often cooperating departments. Line department officers are the technical working groups that implement programs and procedures, usually defined by the city council.

Most sound practices need implementation by line departments that may be hesitant to take ownership if they do not feel that climate change is within their mandate. The mitigation and adaptation actions concerning a line department should be structured as an activity of that department.

In most of the reviewed cases, even when only one office has been formally committed to climate change and/or disaster risk management, several line departments are involved in the process. Over-arching goals like climate change and disaster risk management have sometimes given way to concerns about resources, governance, and organizational mandates inside city departments. Intersectoral collaboration is not a self-generating or even a self-sustaining phenomenon. It has to be pursued and organized and managed. For example, in Milan and NYC, one department has been appointed, but is strictly cooperating with many others in the city. As a concept, intersectoral cooperation goes against the grain of most government systems. Councillors and officers, usually representing specific disciplinary areas and professional groups, may want to defend their sector's interests and compete with each other over limited budgets. When it comes to climate change and natural hazards, most of the cases show that the competitive characteristics are taken over by a perception that collaboration may actually be favorable, and the interdepartmental barriers are usually blown away.

Singapore, Makati City, and Tokyo are among cities that provide examples of ownership by line departments with the capacity and authority to ensure proper coordination between the various agencies. Programs report to and are monitored by high-level institutional mechanisms.

SOUND PRACTICE 4/ PREPARING A CLIMATE CHANGE STRATEGY

Developing a strategy on climate change will help to articulate a prioritized roadmap for the city to reduce impacts through mitigation, adaptation and knowledge management policies and activities. Since most EAP countries are at the early stages of developing their own strategies, cities may want to collect and consolidate available documents on these national strategies, related documentation developed by donors or multilateral institutions, and other policies and regulations that could be applicable. There are important steps to follow in articulating a strategy: (a) identify the major knowledge gaps, specifically in terms of the likely physical (hydrological, geological, etc.), environmental, and health/social consequences of climate change and variability in the city area; (b) identify the main expected social, economic, and environmental impacts of different climate scenarios; (c) describe the actions/activities already in place or programmed and evaluate their ability to design present and future scenarios and their capacity to propose effective solutions and required investments; (d) identify the most urgent actions to be taken in terms of development and dissemination of information, policy changes, capacity building, and identification and design of appropriate institutional structures and incentives; (e) find local/national champions who endorse the strategy;

Developing a strategy on climate change will help to articulate a prioritized roadmap for the city to reduce impacts through mitigation, adaptation and knowledge management policies and activities.



(f) evaluate consistency with other national programs; and (g) provide a framework for annual business planning.

Tokyo, Japan. The Tokyo Climate Change Strategy defines a basic policy for the 10-Year Project for a Carbon-Minus Tokyo, an ambitious undertaking launched by the Tokyo Metropolitan Government at the end of January 2007. The policy spells out a basic framework of climate change mitigation strategies that the Tokyo Metropolitan Government intends to carry out over the next 10 years. Representative measures designed to cope with climate change are identified. This policy specifies the direction in which the Government's climate change mitigation strategies should be pushed forward, based on the details of a study that the Tokyo Metropolitan Environment Council conducted, as well as on an interim report submitted by the Council, in preparation for a revision to the Tokyo Metropolitan Environmental Master Plan.

Essentially it is the Japanese Government's primary responsibility to carry out climate change mitigation measures. Fundamentally, the Japanese Government should come forward with a national-level strategic policy and targets to address the climate change issue. However, the Tokyo Metropolitan Government has noted that the Japanese Government has failed to come up with medium- and long-term reduction targets or effective and specific measures. The Tokyo Metropolitan Government has advanced the world's highest-level strategies in its Tokyo Climate Change Strategy on behalf of the Japanese Government and has taken the lead in developing Japan's climate change mitigation measures. The Tokyo Climate Change Strategy is far more ambitious in its objectives and scope than Japan's commitment under the Kyoto Protocol. This strategy is an outcome from the Tokyo Metropolitan Government's commitment to a more sustainable future and its objective to improve the city for the future generations.⁴⁰

Milan, Italy. Milan is committed to drastically reducing its emissions. Using the year 2000 as a reference point, it plans to cut GHG by 15 percent by 2012 and 20 percent by 2020. Milan's climate program focuses on cutting emissions from residential energy use and transport, yet it is also based on a programmatic approach that takes into account all the factors of producing, collecting, and absorbing emissions. Milan's strategy on carbon dioxide is among measures designed to deliver an organic and programmed reduction of greenhouse gases, directed at the principal sources of its emissions: household energy use and the transport sector.

The City of Milan is also promoting its own climate program specifically for an Expo 2015 bid. Milan not only intends to reduce emissions generated during the preparation, staging, and aftermath of the event by adopting mechanisms to offset these emissions, but more specifically to propose new mechanisms and experimental projects to generate emission credits, attract ideas, and export the best technologies or sound practices and skills to other countries. Milan is promoting new initiatives compatible with the Kyoto Protocol (carbon fund schemes) to design and test genuine applications to be shared and implemented jointly with other European cities and developing countries. Milan's experimental proposals go beyond the terms of the Kyoto Protocol, while maintaining the approach, time horizon, size of commitment, and voluntary nature of the European Union scheme.

Albuquerque, New Mexico, USA. As a show of leadership and commitment, Albuquerque Mayor Martin J. Chávez was the first mayor to sign the U.S. Conference of Mayors Climate Protection Agreement. The Mayor is also a member and co-chair of the U.S. Conference of Mayor's Urban Water Council and was part of a group of U.S. mayors who issued the bipartisan Mayors Statement on Global Warming.

Seattle/King County, Washington, USA. Moved to make a difference, King County started its efforts by making clear its intent to engage in dealing with climate change impacts. A bold goal for the region was established—by 2050 the county will see climate stabilization or 80 percent reduction of GHG emissions below today's levels. The 2007 King County Climate Plan is the first response to the executive orders on Global Warming Preparedness of March 2006 and the King County Council Motion 12362 of October 2006 that provides an overview of how King County seeks to reduce GHG emissions and works to anticipate (mitigate) and adapt to projected climate change impacts, based on the best available science. A Climate Change Team was formed comprised of the Executive Office and Departments of Development and Environmental Services, Executive Services, Natural Resources and Parks, Public Health, and Transportation. Interestingly, the Department of Emergency Management was not included in the Team.



Seattle, Washington, USA

Thua Thien Hue Province, Vietnam. A Development Workshop has helped communities in Central Vietnam since 1999 to reduce their vulnerability to climate-related hazards, including winds, floods, tropical storms, and typhoons. Cyclone intensity appears to be increasing, and at the grassroot level, various social and economic factors have contributed to increased vulnerability of urban and rural communities to the impact of climate-related disasters. Two social groups are particularly at risk: the extremely poor, who live in fragile conditions that the Government attempts to alleviate through its temporary housing replacement program; and those who, on their own, have improved their housing, which may not be disaster resistant. The risk of loss and damage to housing is increasing because families do not apply the basic rules of storm-resistant construction (so that costly materials and structures are not easily destroyed) and follow the trend toward a more urban form of housing with very flat roofs which pose a high risk of damage.

With support from the European Commission, the Development Workshop promotes the application of storm-resistant principles in existing and new housing in Central Vietnam. Typhoon Xangsane in October 2006 caused extensive damage to property, but many families were quick to apply Development Workshop principles in their reconstruction work. The Thua Thien Hue provincial authorities issued a decision in October 2006 instructing local authorities and the population to apply the 10 key storm-resistant construction principles introduced by Development Workshop. This

initiative highlights how disaster prevention has to start at the community level, and that for projects to have a broad impact, families need both financial and technical assistance. Such support needs to be underpinned by the Government to have a real and large-scale impact. More information is found at www.dwf.org/vietnam/phongchongbao/index.htm.

SOUND PRACTICE 5/ GENERATING PUBLIC AWARENESS

It is important to raise public awareness on climate change, linking it to the choices and actions at home, work, or play, and eventually galvanizing climate change action through simple changes in lifestyles.

General awareness of climate change is low. The issue can seem far removed from citizens' daily lives, both in terms of its impact and in action that can be taken to mitigate or to adapt to climate change. It is therefore a clear priority to raise public awareness on climate change, linking it to the choices and actions at home, work, or play, and eventually galvanizing climate change action through simple changes in lifestyles. Public awareness policies may vary widely across cities; however some measures are common: (a) information, education, and training; (b) public participation and stakeholder engagement; and (c) motivation and empowerment of people to take effective action on climate change.

Rockville, Maryland, USA. Rockville's Commission on the Environment took a prominent role in sponsoring and facilitating community dialogue and discussion on sustainability and environmental issues. The Public Works Department issues, posts, and distributes an annual Environment and Sustainability Report on Rockville's progress toward reaching the recommendations and goals of this strategy. The city has established a "green building features" award to recognize architects and developers who voluntarily incorporate green features into Rockville residential and commercial buildings. The city also sponsors a "green" art exhibition and green art workshops to promote conservation and sustainability messages. All city departments engage neighborhood associations, civic organizations, the Chamber of Commerce, and schools to develop and promote a sustainable, environmentally friendly city by developing outreach information and education materials for distribution to residents.

Singapore. The Climate Change Awareness Program was launched by the Ministry of Environment and Water Resources (MEWR) on Earth Day, April 22, 2006. The Climate Change Awareness Program is spearheaded by the Singapore Environment Council and supported by the National Environment Agency as well as the Climate Change Organization and Shell Oil Company, representing a true link of the public and private sectors. With a theme entitled "Everyday Superhero," the program aims to raise awareness among households and motorists on the basic principle of climate change, as well as to show Singaporeans how, through simple and painless habits that save energy and money and reduce GHG emissions, they can all become superheroes every day. Examples of these habits are given in the Climate Change Awareness Program website at www.everydaysuperhero.com.sg.

Makati City, Philippines. Makati City has initiated several programs to improve public awareness of climate change and to encourage people's participation in the climate change management programs. Special public awareness programs target school children, families, shop owners and open-air vendors, and other stakeholders. The city has also developed programs to reduce GHG emissions by involving these stakeholders. Other public awareness programs include Environment

Month, Earth Day, and Earth Hour. Information, education, and communication materials are regularly distributed by the city to improve public awareness.

Dagupan City, Philippines. The Technical Working Group of the City Disaster Coordinating Council of Dagupan City consists of the heads and staff from all relevant departments. The Technical Working Group works closely with the community to inculcate a culture of safety in public life. The Group has also worked to strengthen the Barangay Disaster Coordinating Council (Community Council) in eight high-risk areas. The people in high-risk areas have also assessed their own risk, including preparation of hazard maps (earthquake, flooding, tsunami, and typhoon surge) with the assistance of the City Disaster Coordination Council so that they have a clear understanding of their vulnerability. The city was awarded the prestigious Kalasag Award in 2007 for these efforts.

Albay Province, Philippines. Public communications and training is one of the fundamental principles of the climate change initiatives of Albay Province. Over 720 Barangay officials have been trained in disaster risk management and climate change adaptation. The school children in the province undergo frequent sensitization of the climate change impacts and disaster risk management programs.

SOUND PRACTICE 6/ ACCOUNTING AND REPORTING FOR MITIGATION: THE GHG INVENTORY

If you can't measure, you can't manage. If a city does not know the amount of GHG produced in its area by its (and others') activities, it cannot plan the right policies. Environmental reporting encourages proper disclosure of an organization's environmental performance and promotes transparency of decisions where they may impact the environment. Accounting and reporting for environmental performance is increasingly important to reduce costs, improve processes, and meet stakeholder expectations, particularly in a high-fuel-price environment.

*If you can't
measure, you can't
manage.*

Singapore. Companies and institutions such as Singapore Airlines; ST Microelectronics; Sony Electronics; City Developments, Ltd.; and Singapore Polytechnic already issue environmental reports in which they account for their GHG emissions. In view of the environmental challenge posed by climate change, the Government plans to encourage corporate reporting of carbon dioxide (CO₂) emissions among its power generation companies, as well as among large energy-using companies, to raise awareness of energy usage and thereafter to help identify areas for efficiency improvement.

Milan, Italy. A detailed atmospheric emission inventory for the Lombardy Region, including Milan, a highly industrialized area of about 9 million inhabitants, was published for 2001 and 2003 and shortly will be published for 2007. The inventory is based on a database named INEMAR (INventario EMissioni in ARia) and considers about 220 activities and 12 pollutants—sulfur dioxide (SO₂), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC), methane (CH₄), carbon monoxide (CO), carbon dioxide, ammonia (NH₃), nitrous oxide (N₂O), total suspended particles (TSP), particles of 10 micrometers (PM₁₀), particles of 2.5 micrometers (PM_{2.5}), and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs). In the last couple of decades, the city started working on monitoring, accounting, and reporting pollutants. Greenhouse gas emissions in the City of Milan in 2005 amounted to 5,803.47 kton CO₂. This represents the sum of CO₂ equivalent tons



of emissions from various sectors, such as agriculture, mechanical sources, industrial and nonindustrial combustion, fuel extraction and distribution, manufacturing, power generation and transformation, road transport, waste treatment, and solvents.

Makati City, Philippines. Makati City started its accounting of its GHG inventory in 2004 with assistance of the International Council for Local Environment Initiatives (ICLEI). The city considers GHG emissions from transportation sector, waste, and energy consumption. The city government is using data from the GHG inventory to target large emission sources to implement mitigation programs.

SOUND PRACTICE 7 / CATASTROPHIC RISK FINANCING AND TRANSFER MECHANISMS

Despite their growing exposure and vulnerabilities to hazards, developing countries retain most of the attendant risk due to the undeveloped state of their domestic insurance markets' inability to transfer risk to international reinsurance markets.⁴¹ Even the small amount of insurance coverage that is available in practice tends to be limited to major commercial properties in urban areas, with the level of insurance penetration for homeowners and small businesses in most of these countries being negligible. Catastrophic protection for higher-income homeowners is sometimes present in middle-income emerging markets. The key development constraint of insurance markets is the low per capita incomes of consumers who have less discretionary income, fewer insurable assets, and who present a high cost in accessing and servicing commercial insurers.

The domestic insurance companies in developing markets tend to be undercapitalized, and most do not have the capacity to cover the risks of natural disasters. As a result, whatever limited catastrophic risk coverage they offer has to be largely reinsured through international markets where pricing has become highly volatile in recent years. As a consequence of the limited domestic insurance coverage for catastrophic risks provided by local markets and a lack of economic incentive to engage in *ex ante* risk management, governments generally respond to natural disasters after the fact, relying on donor grants and domestic budgets, including diversion of resources from other planned development projects. While *ex post* disaster funding from donors and international development banks can be an important part of the government's catastrophic risk management strategy, overreliance on this approach has a potential downside, namely an attendant lack of economic incentives for countries to engage in proactive risk management and emergency response capacity building.⁴²

London, England, UK. The Association of British Insurers (ABI) first identified serious concerns about the state of the UK's coastal defenses in the early 1990s, based on joint research undertaken with the then National Rivers Authority (now the Environment Agency). Then ABI examined the effectiveness of the Thames Barrier system protecting London and concluded that this "would serve most Londoners well during its design life."⁴³ Since then they have looked at how and where flooding occurs, funded research into how urban drainage systems will cope with climate change, and looked into how houses might be made more resilient to flooding. ABI has also investigated the flood risks associated with developments in the Government's Growth Areas and found that national flood risk—the damage expected as a long-term average—could increase by 5 percent unless sensible flood risk management steps are taken.

As a consequence of the limited domestic insurance coverage for catastrophic risks provided by local markets and a lack of economic incentive to engage in ex ante risk management, governments generally respond to natural disasters after the fact, relying on donor grants and domestic budgets, including diversion of resources from other planned development projects.



The floods that took place in the summer of 2007 served as a final wake-up call for the Government. Deferring action now will simply increase the cost of action later and will cause immense personal suffering in the interim.

The summer floods presented the insurance industry with one of its biggest ever challenges: The scale of the flooding across the UK was massive, exceeding all events since flood coverage was introduced as a standard feature of property policies in the early 1960s. The industry has responded to around 165,000 claims, with around 120,000 household claims, 27,000 commercial claims, and 18,000 motorist claims. The cost to insurers was estimated around £3 billion, the largest natural catastrophe insurance loss ever recorded in the UK.⁴⁴ This is equivalent to four years of normal claims experience.

In the UK, the insurance industry plays a key role in helping customers and communities rebuild their homes and schools, restart their businesses, and replace their damaged fixtures and fittings and possessions.

Bogota, DC, Colombia. The Bogota Disaster Vulnerability Reduction Project was launched in 2006 by the World Bank with the aim of strengthening the capacity of the Capital District (DC) to manage disaster risks and reduce its vulnerability in key sectors. This project is the second phase of a program that supports interventions in key regions that combine high vulnerability to natural disasters with a high level of economic activity and contribution to the country's GDP. In particular, the project is supporting the following activities:

- Enhance the capacity of the Bogota, DC, to identify and monitor risks by upgrading hydro-logic, seismic, and volcanic detection and forecasting systems, as well as conducting vulnerability assessments that will help Bogota better target its investments and identify potential calamities before they occur;
- Continue the city government's existing risk reduction efforts to ensure the functioning of critical facilities and lifeline infrastructure in the event of adverse natural or technological catastrophes;
- Strengthen the district administration's effectiveness and capacity to prepare for, respond to, and recover from significant emergencies through the provision of training and equipment;
- Increase awareness at the community level about the importance of risk mitigation and disaster preparedness through activities such as education in disaster management and the preparation of emergency response plans; and
- Develop a risk financing strategy for losses arising from natural disasters, which will provide the Bogota, DC with a financial strategy that guarantees the appropriate resources needed for disaster reconstruction or rehabilitation.

SOUND PRACTICE 8/ DEVELOPING A DISASTER RISK MANAGEMENT SYSTEM CONSIDERING CLIMATE CHANGE IMPACTS

Most hazards that lead to disasters cannot be prevented. But their severity can be reduced or mitigated. Planning to reduce the impact of disasters is not new. The international community has made substantial efforts to reduce the impact of disasters on people and livelihoods through both natural

The main operations in Singapore follow a four-pronged system: warning, protection, rescue, and 3Cs (command, control, and communication).

and technological triggers. Many techniques to prepare for, to reduce potential losses from, and to respond and adapt to hazards have been developed.⁴⁵ Disasters can erase the benefits of development investments, and poorly planned development interventions may exacerbate the impact of disasters. Therefore, disaster planning is a necessary step to sustainable development. Moreover, an integrated approach that recognizes climatic as well as other natural disasters in a multihazard way will present a stronger front to mitigating against disasters.

Singapore. The Singapore Civil Defense Force is the primary agency responsible for disaster response in the city. Headed by a commissioner and under the purview of the Ministry of Home Affairs, the Civil Defense Force provides firefighting, rescue, and emergency ambulance services, and also formulates, implements, and enforces regulations on fire safety and civil defense. The Civil Defense Force has set up an islandwide disaster management system to respond to various natural and man-made hazards. The main operations in Singapore follow a four-pronged system: warning, protection, rescue, and 3Cs (command, control, and communication).



New York City, USA

New York City, New York, USA. The New York City Department of Environmental Protection (NYCDEP), responsible for managing the NYC water supply, sewer, and wastewater treatment systems, has developed a climate risk management framework through its Climate Change Task Force. This government-university collaborative effort is set up to ensure that the NYCDEP's strategic and capital planning takes into account the potential risks of climate change—sea-level rise, higher temperature, increases in extreme events, changes in drought and flood frequency and intensity, and changing precipitation patterns—on the city's water systems. This approach will enable NYCDEP and other agencies to adapt management, investment, and policy decisions over the long term as a regular part of their planning activities. The framework includes a

nine-step adaptation assessment procedure. Potential climate change adaptations are divided into management, infrastructure, and policy categories and are assessed by their relevance in terms of climate change timeframes (immediate, medium, and long term); the capital cycle; costs; and other risks. The approach focuses on the water supply, sewer, and wastewater treatment systems of New York, but has wide application for other urban areas, especially those in coastal locations.

In 2006, New York prepared an emergency response plan. If the time came to enforce the plan, a team of more than 34,000 city employees would lead the mobilization effort, bringing residents to evacuation shelters throughout the city. The fire department would assist in evacuating the elderly

and infirm from hospitals and nursing homes. Mass transit would also be used in the evacuation process, with fares and tolls waived.

Tokyo, Japan. The city makes effective use of the Fireproof Promotion Program and has improved the subsidy system to make buildings fireproof and to encourage joint civic-business reconstruction of old buildings. The Tokyo Metropolitan Government has designated key disaster prevention areas as fireproof districts. A master plan has been prepared for the construction of a fire-resistant city and promotion of urban redevelopment for disaster prevention to eliminate districts where firefighting activities are difficult, making use of methods suited to each district.



Tokyo, Japan

Tokyo experiences problems with floods mainly along the small- and medium-size rivers in the Yamanote area (Tokyo's hilly region) and the Tama area. Flood problems are also experienced in basins where the water-retaining capacity has declined due to increasing number of residential properties. In addition, flash floods are also recurring with higher frequency, resulting in the need for flood prevention measures. The Metropolitan Government has planned measures, such as the repair of river embankments, to make rivers capable of disposing of rainfall of up to 50 millimeters per hour. The Government has also planned to improve and expand adjustment reservoirs, diversion channels, and sewerage to eliminate quickly the danger of floods. In order to promptly and correctly counter local changes in precipitation and the danger of high tides, the Government has decided to make effective use of the comprehensive flood prevention information system. Concurrently with the expansion and improvement of rivers and sewerage, the Tokyo Metropolitan Government is constructing facilities to store rainwater and to force permeation into the grounds around public spaces, roads and parks, and large-scale private facilities, for reducing the strain on river basins. There is also a subsidy system to help individuals improve the drainage of their home lots.

Makati City, Philippines. Disaster management activities in Makati City are coordinated by the Makati City Disaster Coordinating Council (MCDCC). The MCDCC includes all relevant departments of the city and provides firefighting, rescue, warning and emergency medical services. The MCDCC operates the city's dispatch center for emergency response, is responsible for developing policies and enforcing regulations, and works closely with the Makati City Environmental Protection Council, which is responsible for climate change management.

Hanoi, Vietnam. The main body for coordinating disaster management in Vietnam is the Central Committee for Storm and Flood Control (CCSFC) with the Department of Dike Management and Flood and Storm Control in the Ministry of Agriculture and Rural Development. The CCSFC has responsibility for gathering data, monitoring flood and storm events, issuing official warnings, and coordinating disaster response and mitigation measures. The CCSFC consists of representatives from the various relevant ministries, as well as the Department of Dike Management, Flood and Storm Control, the Hydro-meteorological Service, and the Vietnam Red Cross. At the provincial, district, and commune levels, local CFSCs are responsible for helping the equivalent People's Com-



mittee to implement flood and storm measures in the territory; organizing dike protection, flood and storm preparedness, and mitigation; and participating with flood recovery and rehabilitation.

The Disaster Management Unit of Hanoi has since developed a Second National Strategy and Action Plan for Disaster Mitigation and Management for the period 2001–2020. One of the basic principles of the Strategy states: “Co-operation and co-ordination between the central level of government, local level of government, state agencies, non-government organizations, and the general public must be well established using a bottom up approach starting at the grassroots level. Similarly, cooperation and coordination of external assistance needs to be strengthened and aggressively pursued.”

SOUND PRACTICE 9/ CLIMATE CHANGE MITIGATION—ENERGY SECTOR

The most common strategies for mitigation in the energy sector are improving power generation efficiency, encouraging the move toward cleaner and less carbon intensive fuels, keeping electricity costs affordable, and developing public/private partnerships.

Albuquerque, New Mexico, USA. In 1994, the city of Albuquerque joined the Department of Energy’s Clean Cities Program, which develops public/private partnerships to promote alternative fuels and vehicles, fuel blends, fuel economy, hybrid vehicles, and idling reduction. Albuquerque is committed to save energy and educate citizens and employees in managing energy consumption. Leadership directed the city to function in a new way, one that operates to make services energy efficient and minimize the use of fossil fuels. One near-term, effective, and visible example of change is the retrofitted traffic signals—replacing incandescent fixtures with light-emitting diodes (LED), using 90 percent less energy, lasting more than 10 times longer (100,000 hours), and shining brighter (www.cabq.gov).

Other conservation accomplishments include (a) energy audits on municipal facilities; (b) conversion of outdated lighting to modern, efficient technology at City Hall, parking structures, police substations, fire stations, and community centers, resulting in an energy savings of 5,000,000 kWh and a financial savings of US\$375,000 per year; (c) and legislation to set aside 3 percent of city bond revenues for energy conservation and renewables. This legislation was passed by the City Council in September 2006. The program started in fiscal year 2007 and continues through 2011.

Singapore. The adoption of more efficient technologies such as combined-cycle gas turbines in gas-fired power plants, has improved Singapore’s overall power generation efficiency from 37 percent in 2000 to 44 percent in 2004, and reduced its CO₂ emissions even further. In terms of renewable energy, solar energy offers the greatest potential in Singapore. However, the cost of generating solar energy through photovoltaic cells is still much higher than conventional grid electricity; Singapore has been involved in various research efforts on renewable energy technologies to increase the yield and lower the cost.

Tokyo, Japan. It is recognized that there is no panacea for climate change mitigation, and all sectors contributing to emissions need to take steps to reduce the CO₂ emissions. While large businesses have the financial capacity to undertake CO₂ reduction, the smaller ones require knowledge and technology. Suitable policy instruments can be used to encourage emission reduction in all segments

Singapore has been involved in various research efforts on renewable energy technologies to increase the yield and lower the cost.



of the city to achieve the 10-year plan targets. Private and public funds and tax incentives can be utilized to carry out necessary investments in energy technologies. The switch to alternate technologies for energy reduction requires huge initial investments. The Tokyo Metropolitan Government intends to create a mechanism that enables it to acquire necessary initial funds and make necessary investments through diverse measures such as collaborating with financial institutions, utilizing the Fund to Promote Measures against Climate Change, and tax incentives. Through these and other measures, the city aims to shift to a low-CO₂ generating society.

Makati City, Philippines. Makati City has achieved tremendous reduction in GHG emissions through reduction in electricity consumption. The city has initiated a major program to replace street lights with more energy-efficient systems with programmable controls. The electricity consumption due to lighting and air conditioners has been reduced in city-owned buildings by using more energy-efficient lighting and modifying the air conditioning duration.

Albay Province, Philippines. Albay Province in Philippines has focused on reducing GHG emissions through the use of greener sources of energy. The province is naturally endowed with geothermal energy sources and recently decided that most power plants should use green energy. The province already generates about 25 percent of its output from geothermal energy.

SOUND PRACTICE 10/ CLIMATE CHANGE MITIGATION—TRANSPORT SECTOR

Typically, cities' objectives are to meet the mobility needs of citizens while minimizing the amount of GHG and air pollutants emitted, to create and operate functioning public transport systems, and to reduce traffic and congestion. Managing the emissions from transport and traffic congestion is generally best achieved through the following policies:

- Managing and controlling vehicular usage;
- Improving fuel efficiency of vehicles and promoting efficient modes of transport;
- Promoting use of cleaner fuels and green vehicles; and
- Developing economic instruments for addressing congestion and pollution in urban areas through regulation.

London, England, UK. London currently suffers the worst air pollution in the United Kingdom and has among the poorest in Europe. The latest government figures show that roadside air pollution in London has been on the rise for the last two years. The London Low Emission Zone (LEZ) aims to improve air quality in the city by deterring the most polluting vehicles from driving in the area. The vehicles affected by the LEZ are older diesel-engine lorries, buses, coaches,

London, England



The London LEZ aims to improve air quality in the city by deterring the most polluting vehicles from driving in the area.

large vans, minibuses, and other heavy vehicles such as motor caravans and motorized horse boxes. Cars and motorcycles are not affected by the scheme. The LEZ commenced on February 4, 2008, for trucks over 12 tons, with different vehicles affected over time; tougher emissions standards will be introduced in January 2012. The LEZ is enforced using fixed and mobile cameras that read the vehicle's registration number plate when driving within the zone. This is then checked against a database of registered vehicles that meet the zone emissions standards. If the vehicle does not meet the LEZ standards or qualify for an exemption or discount, the driver must pay the daily charge, which is currently between £100 and £200.

Milan, Italy. Ecopass came into effect on January 2, 2008. It is designed to restrict access to the central *Cerchia dei Bastioni* area (downtown delimitation) of Milan by charging heavily polluting vehicles (cars are included). Aims of Ecopass are:

- Making the air cleaner by reducing particulate matter emissions in the *Cerchia dei Bastioni* by 30 percent, with a positive fallout on the surrounding areas of the city;
- Relieving congestion by reducing the number of incoming cars by 10 percent and thereby speeding up public transport in the area; and
- Boosting public transport by reinvesting all Ecopass charges in sustainable traffic and a sustainable environment.

Seattle/King County, Washington, USA. King County has developed an extensive program on public transport. Transportation programs include:

- Building a green fleet of hybrid buses and cars;
- Leading a regional consortium to purchase heavy-duty trucks;
- Using 20 percent bio-diesel, along with other clean fuels, to run Metro and other diesel-powered county vehicles;
- Developing intelligent transportation systems that support climate-friendly community planning and transportation choices;
- Expanding regional parks and trails systems; and
- Joining of the first U.S. mass transit system with the Chicago Climate Exchange, a voluntary market committed to reducing GHG emissions.

Singapore. The city has worked to manage vehicle usage through integrated land-use planning and congestion control measures, such as electronic road pricing, and by providing an efficient public transport system, which provides alternatives to driving. Other schemes that help to reduce the need for vehicle ownership and usage include the Off-Peak Car scheme; car-sharing schemes by Honda Diracc and NTUC Income; and the Park-and-Ride Scheme, which allows drivers to park their cars at a discounted rate at car-parks near public transport hubs and interchanges and then to continue the journey by mass rapid transit or bus. Moreover, a voluntary fuel economy labeling scheme has been in place since 2003, where the fuel efficiency of the participating car model is displayed in car showrooms. This helps consumers make more informed decisions in the purchase of a vehicle.⁴⁶

Jakarta, Indonesia. Jakarta has introduced two initiatives that have reduced traffic congestion and have significantly reduced the GHG emissions from the transportation sector in the city. An early initiative implemented in 2003 was to demarcate some major arterial roads as “three-in-one” during morning and evening rush hours. Private vehicles were allowed on these roads only when there were at least three occupants in the vehicle. This initiative was far more ambitious than similar ones in other parts of the world where only a few lanes are dedicated for vehicles with more occupants. The rule has had some positive impact on the reduction of traffic congestion during rush hours and the consequent benefit in terms of reduction in carbon emissions. Strict implementation of this system has also led to positive behavioral change among commuters who now tend to consider the timing of restriction in their movements. In its second initiative, in 2004, Jakarta implemented a rapid bus transportation system using dedicated bus lanes. These bus lanes have access control and are used to operate low-pollution buses with very quick service frequency (waiting time of around two to three minutes during rush hour). The rapid bus transportation network has gained wide popularity, and the city intends to cover more arterial roads in the future.

In 2004, Jakarta implemented a rapid bus transportation system using dedicated bus lanes.

Makati City, Philippines. The mitigation programs in the transportation sector have been developed to reduce atmospheric pollution as well as GHG emissions. The city is the commercial capital of the Philippines and experiences heavy commercial vehicle traffic. These vehicles were often identified as a major source of pollution. The city has launched antismoke-belching campaigns to prevent polluting vehicles on the city’s roads. The government-owned public transportation system is also being made environmentally friendly by using low-pollution fuels and bio-fuels. Jeepneys (jeep jitneys), which constitute a vast proportion of the privately owned transportation system, are being refitted to use electricity, and are now called as e-jeepneys. All these transport sector programs are important components of the city’s aim to reduce total GHG emissions by 20 percent in 2010 compared to its 2003 level.

Dongtan, China. Dongtan proposes to have only green transport movements along its coastline. People will arrive at the coast and leave their cars behind, traveling along the shore as pedestrians, cyclists, or passengers on sustainable public transport vehicles. The City will be linked by a network of pedestrian walkways. Several measures on transport have been planned, such as the following: (a) an intranet service will connect people who want to share a car and forecasts travel times; (b) zero-carbon vehicles will be allowed only within the city; (c) pollution-free buses, trams, or water taxis, powered by fuel-cells or other zero-carbon technologies, will run between neighborhoods; and (d) traditional motorbikes will be forbidden, replaced by electric scooters or bicycles.

Albuquerque, New Mexico, USA. Albuquerque has invested in alternative energy fuels for bus service, created bike paths, and encouraged public modes of transport to limit the use of fossil fuels. Albuquerque, with support from planners and community groups, has made the connection between good planning and the community’s health by creating and maintaining safe, attractive, and accessible walking environments. A series of walking tours are available and promoted by the city to get people out for their health and to enjoy the city’s built and historic and natural environments. The city has taken several measures to create alternative transportation options:



- Launching the Rapid Ride bus system that operates 12 60-foot articulated buses;
- Launching a downtown shuttle bus (D-Ride), which connects commuters to the RailRunner train and other bus routes;
- Launching the Albuquerque–Rio Rancho connection to the New Mexico RailRunner;
- Launching a trolley system from downtown to Old Town;
- Creating a Bike & Ride program to encourage cycling in conjunction with public transportation (in 2006, Albuquerque was named one of “The 21 Best Cities for Cycling” in America by *Bicycling Magazine*, for creating and promoting one of the most extensive Bike Trail Systems in the country); and
- Initiating the program Dump the Pump! Ride the Bus! The city operates 148 buses and 46 paratransit vehicles.

SOUND PRACTICE 11/ CLIMATE CHANGE MITIGATION—BUILT ENVIRONMENT AND DENSIFICATION

Urban planners are looking at the comparatively mitigating effects of high-density urban settlement patterns on GHG emissions. It turns out that city living, as opposed to the suburban alternative, is a much more efficient way of life and generates fewer CO₂ emissions per household.

It can be expected that rising temperatures due to climate change will further increase the demand for cooling. Indeed, most commercial and institutional energy usage comes from air-conditioning and lighting. The typical strategy for the buildings sector is to promote energy-efficient design of buildings, energy-efficient technologies, and energy conservation practices (encouraging greater use of natural light and ventilation, proper insulation, and energy conservation measures). Concerning the household sector, cities are trying to improve their carbon intensity (as their standards of living rise, the energy use does not rise proportionately). These measures could be clustered as energy efficiency standards and labeling schemes, public/private partnerships, or promotion of renewable energy use. Urban planners are looking at the comparatively mitigating effects of high-density urban settlement patterns on GHG emissions. It turns out that city living, as opposed to the suburban alternative, is a much more efficient way of life and generates fewer CO₂ emissions per household. Compared to the suburban alternative, city living is good for the planet.⁴⁷

Albuquerque, New Mexico, USA. In 2007, the city adopted a revised Energy Conservation Code, which aims to reduce GHG by requiring new buildings and existing buildings undergoing alterations to be more energy efficient. The code applies to commercial buildings, multifamily residential buildings, and single-family dwellings. Requirements of the code include:

- Commercial and multifamily residential buildings to be 30 percent more energy efficient than in the past;
- Single-family dwellings to use substantially more insulation, thus reducing energy waste by maximizing heating and cooling;
- Single-family dwellings to use more efficient heating, cooling, ventilating, water heating, and lighting systems; and
- Commercial, multifamily, and single-family buildings to pass Thermal Bypass Inspections, which are designed to inspect insulation installation and ensure tighter buildings with less air leakage (www.cabq.gov/sustainability).



Singapore. Singapore has put in place several initiatives and programs to address mitigation in the built environment. These include government-supported evaluation of energy efficiency in facilities and buildings belonging to large-scale consumers of electricity; development of energy-efficiency norms of buildings; provision of roof-top greenery to reduce the heat island effect; and use of highly insulating building envelope systems for reducing energy requirement of buildings.

Rockville, Maryland, USA. Several long-term policies have been put in place:

- Design green building features and technologies into future city-owned buildings and structures (cross-departmental policies involving Recreation and Parks, Community Planning and Development Services, Public Works Depts.);
- Install a green roof on one or more city-owned buildings or structures capable of supporting such a feature. Design a green roof into new or substantially retrofitted properties (Recreation and Parks, Public Works Depts.); and
- Install off-the-grid energy-generating equipment (solar or wind) at one or more city facilities as feasible (Recreation and Parks, Public Works Depts.).

Seattle/King County, Washington, USA. For historic urban areas and cultural and natural heritage sites under threat, several actions have been recommended:

- Map the most valuable places and the potential threats climate change may represent;
- Build relationships between the regional scientific community and local decisionmakers;
- Raise awareness about sites in danger;
- Seek solutions to reduce GHG emissions in the context of conserving heritage assets such as, where applicable, using green-building principles, retrofitting structures to resist earthquakes, and reducing air toxicity to control surface deterioration of historic buildings;⁴⁸
- Continue to improve the health and climate-friendly aspects of buildings and communities;
- Update the comprehensive plan with a global warming focus; and
- Expand hike/bike trails through (proposed) purchase of Burlington Northern's, 47-mile east-side rail corridor.

Makati City/Philippines. Makati City is the commercial capital of the Philippines, with 50 percent of the country's highest earning, largest, and most profitable corporations based in the city. The city has a night population of around 0.5 million, while the daytime population is around 3.7 million. The city thus experiences very heavy commuter movement on working days. In order to reduce the vehicular traffic and encourage walking within the business district, a public-private program has been launched to connect the tall buildings with elevated pedestrian walkways. The pathways ensure that the people can travel from one building to another without mingling with the road traffic. The use of these walkways is expected to significantly reduce short-distance vehicle movement between neighboring buildings during the business hours, resulting in reduction in traffic congestion and decrease in GHG emissions.

Vancouver, Canada. In 2007, Mayor Sam Sullivan called on municipalities, as well as senior levels of government, to open the debate on increasing urban density as a way to address global climate change. Mayor Sullivan, in the *National Post* on February 17, 2007, wrote, "Instead of telling Canadians

“We should be talking about how better urban planning and densification of our cities can significantly reduce our impact on the environment.”

to simply check the air pressure in their tires to ensure better mileage, or put energy efficient light bulbs in their suburban homes, we should be talking about how better urban planning and densification of our cities can significantly reduce our impact on the environment.”

The editorial came as the City of Vancouver prepared to launch a three-month series of public meetings and idea forums focused on EcoDensity, an initiative that introduces more high-quality densification that will contribute to making Vancouver greener, more sustainable, more livable, and more affordable. EcoDensity explores increasing density in a variety of contexts in lower density areas, along transit routes and nodes, and in neighborhood centers. Of key importance is to support density that is high quality, attractive, energy efficient, and respectful of neighborhood character, while lowering the city’s GHG emissions. Vancouver citizens, business people, and those in the development, housing, social services, and environmental community will have an opportunity to voice their opinion through city-held consultations and provide input to some of the city’s questions (www.vancouver.ca/ecodensity):

- Do people want the City to allow more flexibility in its bylaws to promote sustainable building practices such as using alternative energy sources (e.g., solar and geothermal energy systems), green roofs, recycled rain water, and recycled building materials?
- Should the City make it easier for residents in single-family zoned areas to build a secondary suite above their garage, or convert their garage to a coach house?
- How does the City encourage the creation of more secondary suites? Should we require that any new single-family home rough in a secondary suite?
- Do people want the City to take more advantage of streets and nodes well served by transit, or areas located around Skytrain and future Canada Line stations, by increasing density significantly in those areas?
- What aspects of the city’s bylaws need to be changed in order to better accommodate or promote sustainable building practices, such as energy-saving systems, recycling of gray water and rain-water, green roofs, etc.?
- Should the City reduce its parking requirements on new developments, and if so, which type of developments? Should the City require spaces for car sharing, or electric plugs in new underground garages to promote the use of electric vehicles? Should the city establish car-free neighborhoods?
- How can the City help ensure that the necessary community amenities are included in areas where only smaller, incremental developments are built?
- How could the City promote a greater range of types, sizes, locations, and tenures of housing?

SOUND PRACTICE 12/ CLIMATE CHANGE MITIGATION—FORESTRY AND URBAN GREENERY

There is growing acceptance that the environmental benefits of forests extend beyond the traditional ecological benefits and include the mitigation of climate change as carbon sinks. Interest in forestry mitigation activities has led to the inclusion of forestry practices at the project level in most recent city-planning activities.

Albuquerque, New Mexico, USA. Albuquerque has a priority to create open space lands to preserve a high quality of life as evidenced in its safe and green Bosque park area, carbon sink creation, and city beautification. This priority, combined with the landscaping mandate for native plants that require little water, is both reducing global warming and working to create a water secure city.

Venice, Italy. The idea to give the city of Mestre (Venice) a big periurban forest originated in the City Administration of Venice in the 1980s. The goals of the Venetian administration in reconstructing a part of the forest that once covered the Venetian Po Plain (*Quercus Carpineto Planiziale*) were to clear the air and treat the water that runs into the Lagoon, contribute to the water security of the city of Mestre, renaturalize the territory and increase the biodiversity, create a “living laboratory” of environmental monitoring, provide an area for recreation, and revitalize the historic memory and strengthen the city identity. In the early 1990s, the Region of Veneto, which is responsible for the water treatment of the Lagoon according to a special law for Venice, acknowledged the positive value of the idea and



has included the Woods of Mestre in its program. In this period the collaboration between the two public entities led to the creation of the Osellino Woods (9 hectares), which led to the enlargement of the Carpenedo Woods, which is the last natural remnant of the old forests of the Venetian plain. With the new plan of the City, from 1995 to 1999, the idea of the forest grew into a coherent project. The area defined in the plan has a total extension of over 1,300 hectares and includes large private and public estates. In order to achieve its goals, the City Administration created the Office for the Woods of Mestre, now an autonomous organization, dedicated to the promotion and management of the forest; 20 percent of income from the fees for new construction is planned to go to the Office (fees for secondary urbanization). The City Administration is active in the coordination and creation of culture, which would encourage landowners to plant the trees (offering incentives or financial means from other bodies).

Singapore. With a dedicated program focusing on urban forestry, Singapore has a natural forest with a bounty of unique flora and fauna. Over the years, Singapore has increased the forest area by acquiring adjoining land. The city has also carried out ecologically sensitive afforestation. Introducing ecotourism has the additional benefit of making the forest accessible to citizens, promoting goodwill among the people, and demonstrating the importance of maintaining and improving the forest. Singapore also has a robust social forestry program in which all major roads are provided with green medians and, if possible, green corridors. The distributed greenery ensures that the roads have high CO₂ absorption capacity in close range of the emission source. The roadside greenery aids in reducing the heat island effect.



Makati City, Philippines. Urban greenery has been a major initiative of Makati City since 1992, along with partners from the private sector and civil society. The urban greenery program is primarily aimed at reducing atmospheric pollution. This program includes citywide tree planting in open areas and parks, wherein more than 3,000 trees are planted every year. The city program also focuses on median-strip and roadside greenery. A variety of shrubs have been planted adjacent to the roads for beautification and to reduce pollution. The city has estimated that the additional greenery sequesters approximately 25,000 kilograms of equivalent-CO₂ every year.

Hanoi, Vietnam. The city has a program dedicated to the planting and upkeep of upstream protection forests. An afforestation program targets 5 million hectares to raise forest coverage to 40 percent by 2010.

SOUND PRACTICE 13/ CLIMATE CHANGE MITIGATION—FINANCE AND FINANCIAL MECHANISMS

Learn to develop the capacity to prepare and implement “commercially viable” climate change and hazard management capital projects.

Cities searching for financial support for the capital investments identified to deal with climate change and disaster mitigation and adaptation can look first of all to their domestic capital markets for financing. These programs require budgets for incentives for change and services to supplement and complement local budgets derived from taxes, user fees, and national and state grants for targeted projects. As domestic capital markets in East Asia mature, the opportunity for local government borrowing and accessing the domestic capital market grows. This provides better opportunities for local governments to plan and implement programs because governments can count on a reliable and consistent resource stream. This Primer strongly suggests that local governments learn more about municipal finance and develop the capacity to prepare and implement “commercially viable” climate change and hazard management capital projects.

Among alternative financial measures is carbon finance, which is a means of leveraging new private and public investment into projects that reduce GHG emissions, thereby mitigating climate change and promoting sustainable development. An increasing number of governments and companies are entering the market, which has grown significantly and is expected to increase. The World Bank uses money contributed by governments and companies in Organization for Economic Cooperation and Development (OECD) countries to purchase project-based GHG emission reductions in developing countries and economies in transition. The emission reductions are purchased through a carbon fund on behalf of the contributor and within the framework of the Kyoto Protocol’s Clean Development Mechanism (CDM) or Joint Implementation. Carbon financing works in several capacities:

- Serving as a catalyst in bringing climate issues to bear in projects relating to rural electrification, renewable energy, energy efficiency, urban infrastructure, waste management, pollution abatement, forestry, and water resource management;
- Enabling developing countries to benefit from market mechanisms under the Kyoto Protocol by attracting new technologies (i.e., clean technologies), adding revenues from carbon credits under CDM, and enhancing their ability to attract investors and CDM developers;
- Allowing access to new sectors and policy instruments, such as the Umbrella Carbon Fund since 2006, the China CDM Fund, and other funds managed by the World Bank; and

- Establishing a consolidated capacity-building and technical assistance program to enhance capacity and expertise of host countries to engage in the GHG market.

Seattle/King County, Washington, USA. City bonds are a source for the domestic capital market. King County has tapped into general revenue bonds dedicated for specific projects. These bonds carry greater accountability. For its water reclamation system, King County has issued a US\$29 million bond to finance the capital costs for better management of the new drinking water supply system.

Albuquerque, New Mexico, USA. The City of Albuquerque looked to its domestic capital market for program financing. In introducing the 2007 General Obligation Bond Program and the 2007–2016 Decade Plan, Albuquerque educated its population with a broad campaign on the use of bonds for its projects. Public approval is important to the bond issue when taking on a public financial commitment. Albuquerque received a AA bond rating in 2007 from the Fitch Rating Agency (www.cabq.gov). Credit and bond ratings are important to the domestic capital market and investors, and can identify areas where a city might improve its financial management and project development capacity to help raise capital in the bond market. A city cannot “fail” a credit rating exercise if it perceives the effort to be one to improve its urban financial management capacity.

Albuquerque also used rebates as means of encouraging the public to go green. Water rebates for water efficiency could be earned as well as rebates in building projects for converting to modern, efficient appliances and fixtures: low-flow toilets, water-efficient washing machines, hot water recirculating systems, rainwater harvesting barrels, and multisetting sprinkler timers.

Water rebates for water efficiency could be earned as well as rebates in building projects for converting to modern, efficient appliances and fixtures.

SOUND PRACTICE 14/ ADAPTATION—INFRASTRUCTURE SECTOR

Investment in structural disaster mitigation falls into two main categories: (a) investment in infrastructure to support sustainable socioeconomic development, and (b) investment in infrastructure for reconstruction and recovery. Recent World Bank data⁴⁹ show that the level of investment in infrastructure development in EAP during the past 15 years has been much lower than the economic value of the infrastructure damaged by natural disasters.⁵⁰

Venice, Italy. The approved plan to protect Venice, MOSE (*Modulo Sperimentale Elettromeccanico*, or Experimental Electromechanical Module), involves the construction of 79 gates at three lagoon inlets. When waters rise 1.1 meters (43 inches) above normal, air will be injected into the hollow gates, causing them to rise, blocking seawater from entering the lagoon, and thereby preventing the flooding of Venice. At the Malamocco inlet, the walls of the MOSE project are being built just like the original walls in Venice. But workers are driving 125-foot-long steel and concrete pilings into the lagoon bed, instead of wooden pilings. When the giant doors are at rest, they will be lying on the bottom of the inlet channel, invisible to Venetians and tourists. Each gate will be up to 92 feet long, 65 feet wide, and will weigh 300 tons. Depending on the type of tides, there are different ways to manage the gates. Use of the gates is flexible: workers can close one inlet and not the other, depending on sea tides, wind, and rain. There is no need to close the whole lagoon, and a continuous exchange of water from the open sea to the lagoon can be maintained.



Nam Dinh Province, Vietnam. A range of disaster risk management measures have been identified for Nam Dinh according to the draft Second National Strategy and Action Plan. Although many measures have yet to be implemented and/or enforced, it is instructive to know what has been planned:⁵¹

- Afforest and protect existing upstream forest watersheds to reduce downstream floods;
- Build large- and medium-scale reservoirs upstream on big rivers to retain flood water;
- Strengthen dike systems to be able to resist flood levels;
- Build flood diversion structures;
- Clear floodways to rapidly release flood water;
- Strengthen dike management and protection works to ensure the safety of the dike systems;
- Construct emergency spillways along the dikes for selective filling of flood retention basin; and
- Designate and use flood basins to decrease the quantity of flood water flow.

Other nonstructural measures that have been identified include:

- Models for river flood forecasting have to be developed to give out prompt warnings and to be able to quickly carry out effective response measures;
- The national disaster committee and organizations for flood and storm control from central to local levels of government have to be strengthened to mobilize the work of flood and storm mitigation and management at all levels;
- Legal documents such as the Regulation on Flood and Storm Warning, Ordinance on Flood and Storm Prevention, Ordinance on Dikes, and government regulations on construction of dikes, flood release, flash flood prevention, disaster relief, activities of standing offices for flood and storm prevention, damage measurement and assessment, and others have been prepared and need to be continuously reviewed and strengthened;
- Community disaster awareness should be enhanced through education, training, workshops, and circulation of disaster bulletins;
- Plans in accordance with all probable situations that include disaster specific measures have to be prepared so that disaster damage can be mitigated;
- Shifting the cultivation season has to be studied as a measure to mitigate damage to agriculture production;
- Master plans have to be developed that will mitigate hazards, familiarize and prepare local populations and prepare for evacuation in specific localities where there is no available capability for limiting the impact of frequent disasters; and
- For each disaster occurrence, lessons learned and experience have to be collected for future application.

Navotas City, Philippines. Navotas City in Metro Manila is low lying, and several parts of the city experience inundation of tidal waters for up to 165 days every year. The problem was expected to be exacerbated due to potential impacts of climate change such as a rise in sea level and increase in precipitation. The local government has taken up a program to construct sea walls and pumping stations along the most vulnerable inundation zones. The sea walls have been found to significantly reduce flooding and have been instrumental in the economic revitalization of these zones.

SOUND PRACTICE 15/ ADAPTATION—WATER CONSERVATION AND FLOODING

Most EAP cities have water policies in place. Generally, water policies incorporate (a) quality standards definition and control (drinking water and water courses); (b) conservation of water (usage policies); (c) water availability; and (d) wastewater management (sewage, depurators, and industry).

New York City, New York, USA. The NYCDEP Climate Change Program is designed to encompass the full range of decisionmaking tools required to go from climate impacts and scenarios to project and program adaptation, review, and monitoring. A comprehensive framework for analyzing climate change has been created, including a nine-step Adaptation Assessment procedure:

- Identify risk— proposed project, current infrastructure component, ability to fulfill mandated responsibility;
- Identify main climate change impacts to that project;
- Apply future climate change scenarios;
- Characterize adaptation options—operations management, investments in infrastructure, and/or policy;
- Conduct initial feasibility screening;
- Link to capital cycles;
- Evaluate options—benefit and cost analysis;
- Develop implementation plans, including time frame for implementation; and
- Monitor and reassess.

Potential climate change adaptations are divided into management, infrastructure, and policy categories, and are assessed by their relevance in terms of climate change time frame (immediate, medium, and long term), the capital cycle, costs, and other impacts. The steps take into account changes that occur over time (such as population growth and changes in per capita water use) irrespective of climate change. Potential adaptations are designed to manage the risks of climate change to the NYCDEP infrastructure, providing an overall coping strategy for the agency. The Adaptation Assessment steps are based on standard water-resource planning procedures with the significant addition of climate change and an explicit link to agency capital cycles to provide for efficient incorporation of adaptation during rehabilitation and replacement. While these steps are comprehensive, climate adaptation for particular circumstances may require additional steps (as, for example, securing external funding for adaptation in developing countries).

Singapore. Singapore has scored a resounding success as far as diversifying its water supply sources. With its Four National Taps Strategy in full flow, it has enough water to meet its future needs:

- The first tap is the supply of water from local catchments. This consists of an integrated system of 14 reservoirs and an extensive drainage system to channel storm water into the reservoirs. The Marina Barrage, when completed, will turn Marina Basin into Singapore's 15th reservoir with a catchment area of about 10,000 hectares (or one-sixth of Singapore's land area). Dams will also be constructed across Sungei Punggol and Sungei Serangoon and, when completed

in 2009, will create a new catchment area of over 5,000 hectares. Collectively, these projects will increase water catchment areas from 50 percent to 67 percent of Singapore's land area by 2009, fulfilling one of the Singapore Green Plan (SGP) 2012 targets on clean water.

- The second tap, imported water from Johor, supplements Singapore's needs.
- The third tap, NEWater (high-grade reclaimed water), also supplements Singapore's needs. Thanks to advanced membrane technologies, treated effluent from the water reclamation plants is processed to produce high-grade reclaimed water of drinkable quality. NEWater is supplied from three plants with a combined capacity of 21 million gallons per day. A fourth plant at Ulu Pandan doubles the current supply.
- Recent technological advances have made Singapore's fourth tap, desalinated water, an affordable source. The first desalination plant at Tuas started operations in September 2005 and can supply a maximum of 30 million gallons per day of drinking water. This brings Singapore a step closer to meeting the 2012 target of having nonconventional sources make up at least 25 percent of its water needs.

Following the success in the Four National Taps Strategy, Singapore has now adopted additional programs to ensure efficient, adequate, and sustainable water supply.

Hanoi, Vietnam. Hanoi has a comprehensive water adaptation program:

- Actively improve the flood preparedness and prevention standards for sustainable development (current flood prevention probability level equals 0.8 percent, which should be 0.4 percent, and then 0.2 percent in the future);
- Strengthen the dike system to protect the right bank of the Red River (Asian Development Bank-funded project);
- Strictly monitor, investigate, and respond in dike emergencies;
- Improve the qualitative and efficiency of dike management teams;



Hanoi, Vietnam

- Strengthen the organization and development of dike-guard task forces, local pioneer task forces for dike protection, and search and rescue task forces in the army;
- Clear river bed and unlock river flows to ensure prompt flood discharge in the Red River (lift war-damaged bridges, lower the elevation of inner dike, relocate houses and construction from the restricted barrier of floods, dredge river estuaries deposits);
- Build upstream water reservoirs to control the flood pressures for Hanoi;
- Strengthen and efficiently use flood discharge and slow down construction (strictly follow designed procedures) to protect Hanoi in flood emergencies; and
- Initiate channelization for selected sections of the Red River that flow within the Hanoi zone.

SOUND PRACTICE 16/ ADAPTATION—PUBLIC HEALTH

Climate change has been identified as causing changes in the pattern of communicable diseases throughout the world. It may also lead to more heat-related diseases among the most vulnerable in society—the young, the elderly, the sick and the disabled. Tropical cities have developed specific communicable disease strategies, such as vector control (mainly against mosquitoes, flies, cockroaches, and rodents) and light protection (tents, curtains, etc.).

Singapore. The National Environment Agency administers a comprehensive vector surveillance program, under which it is notified by the Ministry of Health of the number of vector-borne diseases from all hospitals, clinics, and laboratories. The strategy emphasizes a well-established system of vector surveillance that enables the source of an infectious disease to be identified and eliminated before it poses a threat to the population.

Climate change has been identified as causing changes in the pattern of communicable diseases throughout the world.

Sound practice and city	Type of measurement/tool	Ownership	Governance
SHORT TERM = Adoptable in less than 1 year			
1/ Seattle/King County	Questionnaire about climate change impacts	Env. Dept.	Local
2/ New York City	Office of Long-Term Planning & Sustainability	Launched by the mayor	Local
2/ New York City	Stakeholder interactive approach	Env. Dept.	Local
2/ Makati City	Strong institutional mechanisms for facilitating actions on climate change and disaster risk management	City Council	Local
2/ Dagupan City	Technical Working Group to implement activities on climate change	City Disaster Coordinating Council	Local
2/ Albay	Center for Initiatives and Research on Climate Adaptation	Public-private partnership	Local
4/ Tokyo	Climate change mitigation strategy	Tokyo Metropolitan Gov.	Local + Central

TABLE 5.1/ Illustrative list of sound practices

TABLE 5.1/ (cont.)

Sound practice and city	Type of measurement/tool	Ownership	Governance
4/ Albuquerque	Municipality leaders commitment	Mayor's office	Local
4/ Milan	Climate program definition	Env. Council	Local
4/ Seattle/King County	Climate plan	Executive office, Dept. of Dev. and Env. Serv. Dept. of Executive Serv., Dept. of Nat. Res. and Parks, Dept. of Public Health, Dept. of Transportation	Local
4/ Seattle/King County	Team definition	Executive office, Dept. of Dev and Env. Serv. Dept. of Executive Serv., Dept. of Nat. Res. and Parks, Dept. of Public Health, Dept. of Transportation	Local
5/ Rockville	Sustainable report: annual	Commission on the Env. –across Depts.	Local
5/ Rockville	Stakeholder dialogue: continuous	Commission on the Env. –across Depts.	Local
5/ Rockville	Green building features award Award	Commission on the Env. –across Depts.	Local
5/ Singapore	Climate change awareness program	Minister MEWR	Local + Central
5/ Singapore	Everyday superhero	Minister MEWR	Local + Central
5/ Dagupan City	Technical Working Group consultation	City Disaster Coordinating Council	Local
5/ Makati City	Programs to improve public awareness	City Council	Local
5/ Albay	Training of Barangay officials and children on disaster mangement	Province	Local
7/ London	Advice from ABI on land use planning and flood defense	Env. Dept. and Mayor's Office	Local
8/ Tokyo	Rainwater storage	Tokyo Metropolitan Gov.	Local + Central
8/ Tokyo	Individual drainage subsidies	Tokyo Metropolitan Gov.	Local + Central
8/ Makati City	Organization of the City Disaster Coordinating Council	City Council	Local
9/ Albuquerque	Public/private partnership	Dept. of Energy	Local
9/ Albuquerque	LED, education	Dept. of Energy	Local
9/ Makati City	Streetlight replacement	City Council	Local
10/ Milan	Launch of Ecopass	Env. Council	Local
10/ Singapore	Fuel economy label	Env. Dept.	Local + Private Sector



TABLE 5.1/ (cont.)

Sound practice and city	Type of measurement/tool	Ownership	Governance
11/ Seattle/King County	Mapping	County Govt.	Local + Private Sector
11/ Seattle/King County	Raise awareness	County Govt.	Local + Private Sector
11/ Makati	Sustainable Pathways	City Council	Local
12/ Albuquerque	Forest and greening plans	Dept. of Env./Parks	Local
16/ Singapore	Accounting and notification	National Env. Agency	Central
MEDIUM TERM = adoptable in more than 1 year and less than 3 years			
2/ Singapore	National Climate Change Strategy	Ministry of Env. and other depts.	Central
3/ Tokyo	Tokyo Climate Change Strategy	Tokyo Metropolitan Gov.	Provincial, Local
3/ Singapore	National Climate Change Strategy	National Env. Agency	Central
4/ Tokyo	Previous research/studies	Tokyo Metropolitan Gov.	Local + Central
4/ Milan	Experimental proposal	Env. Council	Local
4/ Seattle/King County	Regulation	Executive office, Dept. of Dev. and Env. Serv., Dept. of Executive Serv., Dept. of Nat. Res. and Parks, Dept. of Public Health, Dept. of Transportation	Local
4/ Thua Thien Hue	Key storm-resistant construction principles	Local authorities with Development Workshop (EU donor)	Local
6/ Singapore	Environments report preparation	Minister MEWR	Local + Central, include Private Sector
6/ Makati City	Inventory of GHG with ICLEI	Env. Dep.	Local
7/ Bogota, DC	Bogota Disaster Vulnerability Reduction Project	Mayor office and specific depts.	Local + the World Bank
8/ Singapore	Governance	Singapore Civil Defence Force	Local + Central
8/ Singapore	Disaster management system design	Singapore Civil Defence Force	Local + Central
8/ Tokyo	Fireproof Promotion Program	Tokyo Metropolitan Gov.	Local + Central
8/ Tokyo	Construction master plan	Tokyo Metropolitan Gov.	Local + Central
8/ Hanoi	Data gathering, monitor, warning, coordinating disaster response: continuous	CCSFC and local offices	Local + Central
8/ Hanoi	Strategy development	CCSFC and local offices	Local + Central
9/ Albuquerque	Energy conservation policies	Dept. of Energy	Local
9/ Tokyo	Public/private funds and tax incentives	Tokyo Metropolitan Gov.	Local + Central



TABLE 5.1/ (cont.)

Sound practice and city	Type of measurement/tool	Ownership	Governance
9/ Albay	Geothermal sources for energy	Province	Local
10/ London	Launch of LEZ	Env. Dept. and Mayor's Office	Local
10/ Makati City	Government owned transport fueled by renewable sources	Government	Local + Central
10/ Dongtan	Sustainable transport	SIIC	Local
10/ Jakarta	Rapid bus transit/Traffic computer management	Department of Transport	Provincial
10/ Albuquerque	Pedestrian-friendly development	City Council	Local
11/ Albuquerque	Energy Conservation Code	Env. Dept.	Local + Private Sector
11/ Rockville	Green roof	Several Depts.	Local + Private Sector
11/ Seattle/King County	Relation with scientific community	County Govt.	Local + Private Sector
11/ Vancouver	EcoDensity	Mayor's Office and other Depts.	Local
12/ Makati	Metro tree planting	Env. Dept.	Local
13/ Jakarta	Carbon sinks	Central Government	Local + Central
14/ Nam Dinh	Forest watershed	Provincial Councils	Local + Central
14/ Nam Dinh	Reservoirs	Provincial Councils	Local + Central
14/ Nam Dinh	Flood diversion and flood ways	Provincial Councils	Local + Central
14/ Nam Dinh	Emergency spillways	Provincial Councils	Local + Central
15/ New York	Framework for analyzing climate change	NYCDEP	Local + Agencies + Universities
15/ Singapore	Four National Taps Strategy	Government	Local + Central
15/ Singapore	Desalinated water	Singapore Public Utility Board	Local + Central
15/ Hanoi	Flood preparedness	CCSFC and local offices	Local + Central
15/ Hanoi	Organization strengthening	CCSFC and local offices	Local + Central
15/ Hanoi	Upstream reservoirs	CCSFC and local offices	Local + Central
15/ Hanoi	Flood discharge	CCSFC and local offices	Local + Central
16/ Singapore	Surveillance	National Env. Agency	Central
LONG TERM = adoptable in more than 3 years			
1/ New York	Downscaling climate impacts	Municipality, agencies, university, NASA	Local + Central + Universities
6/ Milan	Inventory database	Regional Council, Env. Council	Local + Regional



TABLE 5.1/ (cont.)

Sound practice and city	Type of measurement/tool	Ownership	Governance
8/ New York	Climate risk management framework	NYCDEP and other agencies	Local + Agencies + Universities
8/ Tokyo	Flood measures	Tokyo Metropolitan Gov.	Local + Central
9/ Singapore	New technologies (combined-cycle gas turbines)	Ministry of the Environment and Water Resources	Central
9/ Tokyo	Switch to renewable energy	Tokyo Metropolitan Gov.	Local + Central
10/ Seattle/King County	Green fleet	Env. Dept.	Local
10/ Seattle/King County	Clean fuels	Env. Dept.	Local
10/ Seattle/King County	New Mobility system	County Govt.	Local
10/ Singapore	Mobility system	National Environment Agency	Local + Private Sector
11/ Singapore	Urban forestation		
11/ Rockville	Green technologies for building	Several Depts.	Local + Private Sector
11/ Rockville	Renewable energy institute	Several Depts.	Local + Private Sector
11/ Seattle/King County	Seek and apply solutions	City administration	Local + Private Sector
12/ Venice	Periurban forest	City administration	Local + Regional + Private Sector
12/ Singapore	Urban forestation	City administration	
10/ Jakarta	Green building initiative	City administration	
13/ Milan	Programmatic Clean Development Mechanism	Env. Council	Local+ Central + other cities
14/ Venice	MOSE negotiation	City Councils	Local + Central + Regional
14/ Venice	MOSE construction	City Councils	Local + Central + Regional
14/ Nam Dinh	Dikes and levees	Provincial Councils	Local + Central
14/ Novotas	Sea walls and pumping station	City Council	Local
15/ New York City	Adaptation assessment	NYCDEP	Local + Agencies + Universities
15/ Singapore	Integrated system (reservoir, drainage)	Government	Local + Central
15/ Hanoi	Dike system	CCSFC and local offices	Local + Central
15/ Hanoi	Canalization	CCSFC and local offices	Local + Central

SECTION

06



THE WORLD BANK

Conclusions

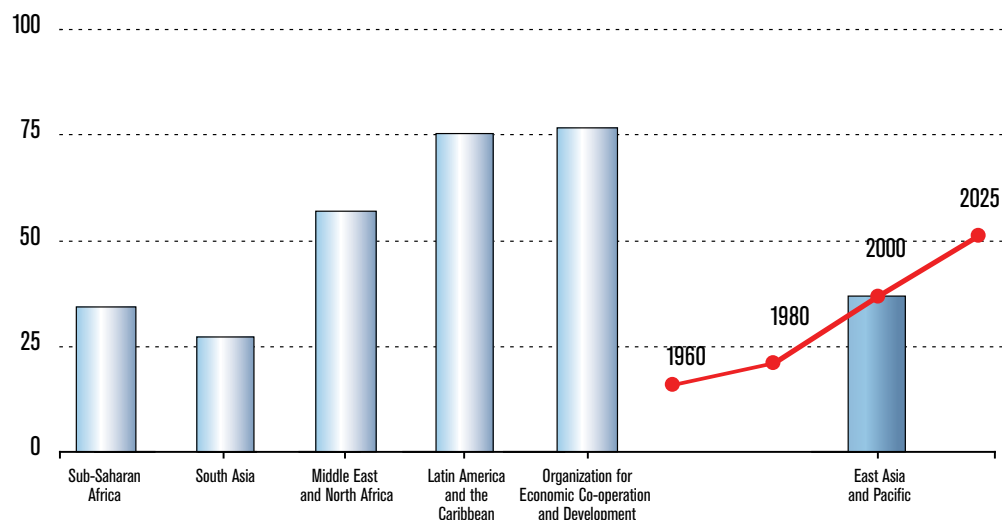
This Primer initiates a learning process for local governments. It looks at the issues of climate change, the potential consequences of climate change that can affect cities, and the critical relationship between current urban development and local government financial trends with climate change, disaster risk management, and sustainable development. The Primer recommends a thorough city self-assessment and a comprehensive information base as starting points; it provides sound practices, case studies, and resources that a city can use as follow-up to building its programs for resilience.

BUILDING A RESILIENT CITY

East Asia is experiencing urbanization at an unprecedented rate (Figure 6.1). The growth is far beyond the capacity of city governments to provide infrastructure and basic civic amenities. As a result, East Asian cities are becoming more vulnerable to the impacts of natural hazards, including those due to potential impacts of climate change. The governance of urban areas is concurrently becoming increasingly decentralized, with greater responsibilities assigned to local governments, many faced with managing immense population growth, often without correspondingly increasing financial resources. And in this mix are the almost-certain risks from unpredicted disasters.

East Asia is highly vulnerable to climate change impacts. It is clear and undeniable that something can and must be done to lower GHG emissions and to attend to the consequences climate change may bring about through sea-level rise, temperature rise, increased precipitation, and extreme events. The most obvious impact on cities, especially those in East Asia, will be more frequent and more severe disasters.

The degree of impact from which cities suffer from climate change will depend on the actions and initiatives local governments take now to build a resilient city. East Asian local governments understand this responsibility and are engaging with authorities to act. Addressing climate change is part of good urban management. City officials need to understand the urban characteristics that make

FIGURE 6.1/ Urban population (% of total) is rapidly increasing in East Asia

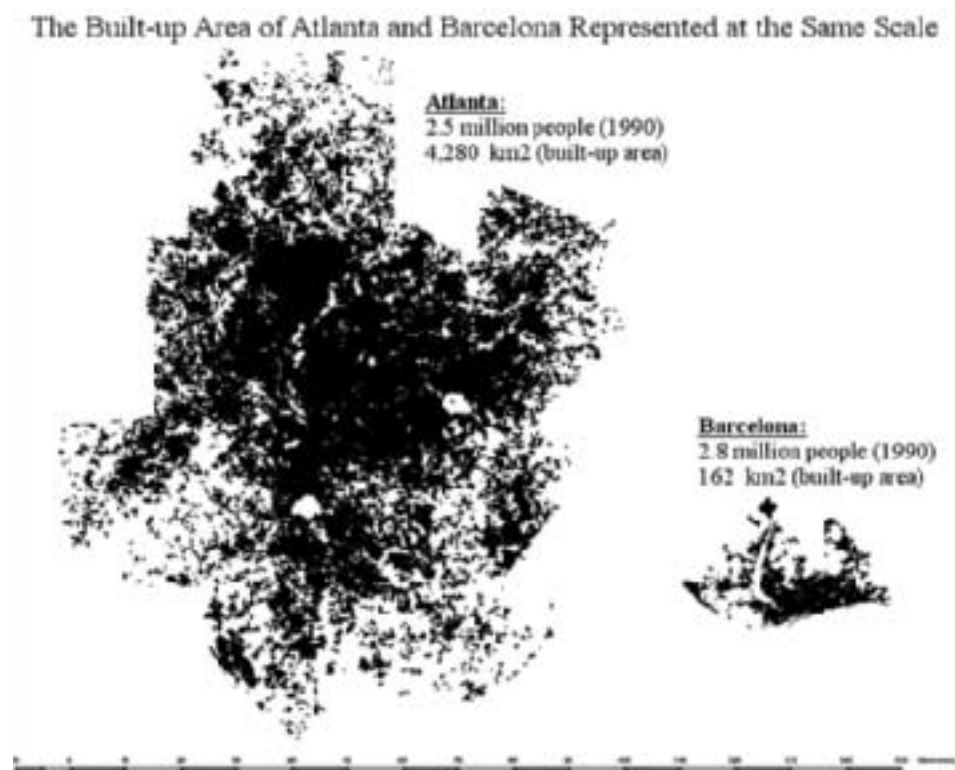
Having compact, efficient, and walkable cities is an important mitigation measure. Equally important is safety in building siting, design, and codes as a key adaptation measure, especially for the poor, to avoid settlements on marginal lands most susceptible to climate change impacts and other natural hazards.

the city susceptible to disaster risk and climate change, such as determining if the city is a Hot Spot. The city needs to establish and manage a consolidated information base that can play a huge part in devising the most appropriate urban management strategies.

The experiences of many cities around the world affirm that a “no-regrets” approach to mitigation and adaptation initiatives can be highly effective and sustainable. This approach promotes the necessary changes in behavior, technology, and policies as simply sound urban management—necessary under any circumstances. When this no-regrets approach is supplemented with specific measures on climate change impact mitigation and adaptation and on disaster risk management, the probability of enhancing a city’s resilience capacity becomes very high. Urban growth should become synonymous with “walkable cities” and energy conservation. Urban development models centered around the automobile, suburban living, and cheap fuel will need to be based on other more efficient conditions. Figure 6.2 shows two cities, Barcelona and Atlanta, with the same population but with Atlanta having 26 times the footprint of Barcelona. Having compact, efficient, and walkable cities is an important mitigation measure. Equally important is safety in building siting, design, and codes as a key adaptation measure, especially for the poor, to avoid settlements on marginal lands most susceptible to climate change impacts and other natural hazards.

However, the high density of people in cities increases vulnerabilities. Eight out of the 10 most populous cities in the world, including 5 in East Asia, have moderate to high earthquake hazard. Similarly, 8 out of 10 of the most populous cities are located on the coast and are vulnerable to storm surges and tsunami waves. Climate-related vulnerability increases not only from flooding due to more precipitation and storm surges, landslides, drought, saltwater intrusion, and typhoons, but also earthquakes and other hazards, particularly where poor quality and ill-maintained infrastructure, low-quality building stock, and lower resilience of high-density urban development come into play. Identifying those vulnerabilities and developing programs to address them is the challenge facing East Asian cities.



FIGURE 6.2/ Urban footprints—the choice facing cities

Source: Bertaud, A., and T. Pöde, Jr., *Density in Atlanta: Implications for Traffic and Transit* (Los Angeles: Reason Foundation, 2007).

There is a strong relationship between climate change impacts management, disaster risk management, and sustainable development. To not take action in all three areas puts at risk any progress in building resilient cities and thriving local economies. To not become better informed about climate change and its consequences diminishes the establishment of practical policies and programs to address impacts and disaster events.

LEARNING FROM OTHER SUCCESSES

There is no single “magic” recipe for successful planning to respond to climate change impacts and disaster risks. There is no single sequence of measures, tools, application, and procedures. The Primer aims to motivate city officials to take actions based on existing sound practices.

The Primer provides sound practices to address the major vulnerabilities and risks. It covers many aspects of successful planning, from defining organizational structures and institutional mechanisms, to generating public awareness and engaging stakeholders. Each illustrative example offers a potential option. Milan has set up an atmospheric emissions inventory. London is defining appropriate risk-financing methods for land-use planning and flood defense. Makati City reduces electricity consumption by replacing street lights with more energy-efficient systems. Albuquerque aims to reduce greenhouse gases by requiring new buildings and renovated existing buildings to be more energy efficient.

The bottom line is to have a strategy that best prepares your city to act and react effectively to climate change impacts and disaster risks.

Nevertheless, any example should be adapted to the specific context of a city as part of its unique management strategy. The Primer narrows its measure of success for a resilient city into four salient points:

- Understand the threats that impact your city;
- Assess the unique characteristics and vulnerabilities of your city;
- Learn from the experience of other cities; and
- Devise a plan “your own way.”

The bottom line is to have a strategy that best prepares your city to act and react effectively to climate change impacts and disaster risks.

TAKING ACTION

The Primer’s approach for a resilient community to deal with climate change impacts and disaster risk management issues utilizes a dual track:

- Engage the local officials with the need to lower GHG emissions and present sound practices of cities that are doing so through mitigation programs of energy efficiency, greater use of nonfossil fuels, control urban sprawl, public transport, recycling of wastes and improvement of water reclamation; and
- Address the consequences of climate change and the increased frequency and intensity of extreme and episodic events, including storm surges and typhoons. Adaptive measures will prepare for and control the conditions and disasters that will be made worse due to climate change.

With the tools the Primer is proposing and the resources it is providing, the city should be better prepared to accomplish the following:

- **Create a Climate Change Impacts and Hazards Workbook** to establish a City Information Base that records and consolidates information describing the city context and particulars of the city’s vulnerabilities and future growth.
- **Set priorities to reduce climate change impacts and address disaster risk.** With the background gathered from the City Typology and Risk Characterization Matrix and the City Information Base, the city should be able to recognize and find ways to address its priorities.
- **Establish a city mandate** through executive orders and city council legislation that articulates commitment and establishes a transparent record to guide, monitor, and evaluate a city’s progress.
- **Identify ways and means of dealing with hazard management** to mitigate and adapt to changing conditions and events.
- **Seek external partners to assist in the process**, either with financial assistance or technical assistance, for defining vulnerabilities and risks and for selecting the most appropriate measures to enhance city resilience and sustainable urban planning.





- **Develop, finance, and implement plans and programs** to accomplish goals. The city needs to set up an action plan that not only defines priorities, but also introduces specific programs, budget, targets, and timelines.
- **Engage citizens and other cities**, partnering to develop a broader and more effective resilient community.
- **Monitor, evaluate, and modify the initiatives** as needed and as the city accomplishments allow.

▲ *Early action today will help to build a more resilient society for future generations.*

Each city must define its own strategy to become a more resilient community. The Primer advocates planning now. The strategy must address climate change impacts according to each city's own vulnerability, risks, and needs. The Primer is a tool to engage the city in training, capacity building, and self-assessment. How to move forward, on the basis of awareness, wisdom, resources, and expectations, comes from the leadership that aspires to see its city and its citizens living in a more resilient environment.

ANNEXES



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Annex A/ Worldwide Programs and Organizations on Climate Change and Hazards

Asia-Pacific Partnership on Clean Development and Climate (AP6) is an international non-treaty agreement among Australia, India, Japan, the People’s Republic of China, South Korea, and the United States announced July 28, 2005, at an Association of South East Asian Nations (ASEAN) Regional Forum meeting. It was formally launched on January 12, 2006, at the Partnership’s inaugural ministerial meeting in Sydney. Foreign, environment, and energy ministers from partner countries agreed to cooperate on development and transfer of technology, to enable reduction of GHG emissions. Ministers agreed to a charter, communiqué, and work plan to “outline a ground-breaking new model of private-public task-forces to address climate change, energy security and air pollution.”

Berlin Mandate. A ruling negotiated at the first Conference of the Parties, which took place in March 1995, concluded that the present commitments under the Framework Convention on Climate Change are not adequate. Under the Framework Convention, industrialized countries pledged to take measures aimed at returning their GHG emissions to 1990 levels by the year 2000. The Berlin Mandate established a process that enabled the parties to take appropriate action for the period beyond 2000, including a strengthening of industrialized country commitments, through the adoption of a protocol or other legal instruments.

Bryd-Hagel Resolution. In June 1997, anticipating the December 1997 meeting in Kyoto, Senator Robert C. Byrd (Democrat of West Virginia) introduced, with Senator Chuck Hagel (Republican of Nebraska) and 44 other cosponsors, a resolution stating that the impending Kyoto Protocol (or any subsequent international climate change agreement) should not “(a) mandate new commitments to limit or reduce GHG emissions for the Annex I Parties [i.e., industrialized countries], unless the protocol or other agreement also mandates new specific scheduled commitments to limit or reduce GHG emissions for Developing Country Parties within the same compliance period, or (b) would result in serious harm to the economy of the United States.”

C40. Clinton Climate Initiative. Former President Clinton launched the Clinton Foundation’s Climate Initiative (CCI) in August 2006, with the mission of applying the Foundation’s business-



oriented approach to the fight against climate change in practical, measurable, and significant ways. In its first phase, CCI is working with the C40 Large Cities Climate Leadership Group, an association of large cities dedicated to tackling climate change—to develop and implement a range of actions that will accelerate greenhouse gas emissions reductions. With cities contributing approximately 80 percent of all heat-trapping greenhouse gas emissions to our atmosphere, while only comprising 2 percent of land mass, large cities are critical to winning this fight and slowing the pace of global warming.

Conference of the Parties (COP). The Conference of the Parties is the collection of nations that have ratified the United Nations Framework Convention on Climate Change (UNFCCC), currently over 150 strong with about 50 observer states. The primary COP role is to keep the implementation of the Convention under review and to take the decisions necessary for the effective implementation of the Convention. The first Conference (COP 1) took place in Berlin from March 28 to April 7, 1995, and was attended by more than 1,000 observers and 2,000 media representatives (also see Berlin Mandate).

International Council for Local Environmental Initiatives (ICLEI). ICLEI was founded in 1990. More than 800 cities, towns, provinces, and their associations are ICLEI members. ICLEI provides information, delivers training, organizes conferences, facilitates networking and city-to-city exchanges, carries out research and pilot projects, and offers technical services and consultancy. Several cities in both developing and developed countries have initiated their climate change management programs with ICLEI assistance.

Intergovernmental Panel on Climate Change (IPCC). The IPCC was established in 1988 by the World Meteorological Organization and the United Nations Environment Programme. The IPCC is responsible for providing the scientific and technical foundation for the United Nations Framework Convention on Climate Change (UNFCCC), primarily through the publication of periodic assessment reports. The Fourth Assessment Report was published in 2007.

Kyoto Protocol. An international agreement, adopted in December 1997 in Kyoto, Japan, sets binding emission targets for industrialized countries that would reduce their emissions, on average, 5.2 percent below 1990 levels, between the 2008–2010 period.

Kyoto Flexible Mechanisms. The Kyoto Protocol creates three market-based mechanisms that have the potential to help countries reduce the cost of meeting their emissions reduction targets. These mechanisms are Joint Implementation (Article 6), the Clean Development Mechanisms (Article 17), and International Emissions Trading.

Montreal Protocol (on substances that deplete the ozone layer). An international agreement that entered into force in January 1989 to phase out the use of ozone-depleting compounds, such as methyl chloroform, carbon tetrachloride, and chlorofluorocarbons. Chlorofluorocarbons (CFCs) are potent greenhouse gases that are not regulated by the Kyoto Protocol since they are covered by the Montreal Protocol.

National Action Plans. National action plans are submitted to the Conference of the Parties by all parties outlining the steps that they have adopted to limit their anthropogenic GHG emissions. Countries must submit these plans as a condition of participating in the United Nations Framework Convention on Climate Change and, subsequently, must communicate their progress to the COP regularly.

Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). The Secretariat comprises the United Nations staff responsible for conducting the affairs of the UNFCCC. In 1996 the Secretariat moved from Geneva, Switzerland, to Bonn, Germany.

United Cities and Local Government (UCLG). United Cities and Local Governments is an NGO and represents and defends the interests of local governments on the world stage, regardless of the size of the communities they serve. Headquartered in Barcelona, it is present in 127 of the 191 UN member states in seven world regions; UCLG's members include individual cities and national associations of local governments, which represent all the cities and local governments in a single country. Over 1000 cities across 95 countries are direct members of UCLG. With 112 Local Government Associations (LGAs), Europe boasts the largest number of LGAs, which represent about 80 percent of the total European population.

United Nations Convention to Combat Desertification (UNCCD). In 1977, the United Nations Conference on Desertification (UNCOD) adopted a Plan of Action to Combat Desertification (PACD). Unfortunately, despite this and other efforts, the United Nations Environmental Program (UNEP) concluded in 1991 that the problem of land degradation in arid, semiarid, and dry subhumid areas had intensified, although there were "local examples of success." As a result, the United Nations Conference on Environment and Development (UNCED), which was held in Rio de Janeiro in 1992, supported a new, integrated approach to the problem, emphasizing action to promote sustainable development at the community level. UNCED also called upon the United Nations General Assembly to establish an Intergovernmental Negotiating Committee on Desertification (INCD) to prepare a Convention to Combat Desertification, particularly in Africa. In December 1992, the General Assembly agreed and adopted Resolution 47/188.

United Nations Framework Convention on Climate Change (UNFCCC). A treaty signed at the 1992 Earth Summit in Rio de Janeiro calls for the "stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The treaty includes a nonbinding call for industrialized countries to return their emissions to 1990 levels by the year 2000. The treaty took effect in March 1994 upon ratification by more than 50 countries. The United States was the first industrialized nation to ratify the Convention.

World Mayors and Local Governments, the Climate Protection Agreement. The World Mayors and Local Governments calls upon all national governments to work through the UNFCCC to adopt commitments to stay within a 2°C threshold increase of the Earth's surface temperature. It specifically calls for a framework that will achieve a reduction of 60 percent GHG emissions from 1990 levels by 2050 globally, with industrialized countries to commit to 80 percent GHG reductions from 1990 levels. Building on the existing commitments of local government leaders and their associations—including the ICLEI Cities for Climate Protection Campaign, World Mayors Council on

Climate Change, the US Mayors' Climate Protection Agreement, C40 Climate Leadership Group, and the United Cities and Local Government (UCLG) Jeju Declaration—mayors and local governments set specific commitments to do the following:

- Reduce GHG emissions immediately and significantly;
- Implement subnational, national, and international frameworks that are complementary and enable local governments by providing resources, authority, and sufficient mandate to carry forward these roles and responsibilities;
- Build a sustainable energy economy through energy savings and the application of new and existing renewable and high efficiency technologies;
- Execute climate change adaptation and preparedness measures through local government planning, development, and operational mechanisms, prioritizing the most vulnerable cities;
- Advocate for local governments; and
- Call persistently for national governments to undertake binding carbon limits to rapidly and significantly reduce GHG emissions in the short term and by at least 60 percent worldwide below 1990 levels by 2050.



Annex B/ Sources of Technical and Financial Assistance

Technical assistance options are often available at the local level through academic institutions and universities that have existing expertise in aspects of climate change and disaster risk management, such as Geographical Information System mapping and hazard modeling. The private sector may be another option to partner with depending on the sector and type of technical assistance required. Another option is to seek assistance at the regional and/or national levels through government agencies and line ministries, such as the Meteorological Department or Geological Survey Department, to gain relevant data and advice specific to your city's typology. Twinning and partnering programs, such as the one featured by Milan and World Bank collaboration, is another way to obtain technical assistance from other cities at a reasonable cost.

The World Bank also provides technical assistance support to its clients on a range of development issues. Technical assistance helps client countries implement policies and programs and build institutional capacity. The technical assistance may focus on organizational arrangements, staffing methods, and technical, physical, or financial resources in key agencies. Specific to disaster risk management and climate change issues, the Global Facility for Disaster Reduction and Recovery also provides technical assistance to governments.

In addition to technical assistance, it is important that the city estimates its financing needs to implement its climate change strategy, as well as determines its options for financial assistance. Apart from a reassessment of priorities to allocate revenues away from counterproductive subsidies (e.g., energy and water) toward climate resilience, cities can also consider alternative instruments such as risk insurance facilities or catastrophe bonds.

Increasingly, as the issue of climate change is recognized as having become a development challenge that can wipe out years of growth, the mainstream development funds from multilateral or regional development Banks, and also sources of bilateral assistance, could become available for climate resilient sustainable development financing with adaptation benefits. A number of specialized climate funds are also emerging that can be useful sources of funding. Innovative city-level programs would receive attention from both these. Climate-related funds will include:

- The United Nations' Adaptation Fund, managed by the Global Environment Facility (GEF), is forecasted to be capitalized at US\$80–300 million per year between 2008–2012;
- Other GEF adaptation program;
- Global Facility for Disaster Reduction and Recovery to provide US\$15–20 million per year worldwide; and
- Mitigation financing with adaptation benefits, such as active carbon-related project funds (e.g. the World Bank's Carbon Partnership Facility).



Annex C/ Examples of Relevant World Bank Projects

The World Bank's role in providing *knowledge products*, *technical assistance*, *grants*, and *investment lending project* for climate change and hazard risk management projects has been increasing and deepening. Information and updates on active World Bank projects in East Asia and the Pacific Region can be found on the specific country page on the World Bank website (www.worldbank.org/eap) or by contacting the relevant country office. Below is a brief description of a few projects from the Bank's portfolio to illustrate the scope of interventions the Bank has been undertaking in collaboration with its clients on Climate Change and Disaster Risk Management.

The Global Natural Disaster Hotspots Project is an example of a *knowledge product* that maps six major natural hazards: cyclones, drought, earthquakes, floods, landslides, and volcanoes. This online, interactive tool provides a basis for identifying geographic areas of highest relative disaster risk potential in order to prioritize disaster risk reduction investments and better inform development efforts. To access the tool, visit <http://geohotspots.worldbank.org/hotspot/hotspots/disaster.jsp>

The **Climate Change Impact and Adaptation in Coastal Cities Project** is an analytical exercise that is being undertaken in collaboration with Japan Bank for International Cooperation (JBIC) and the Asian Development Bank, in which the Bank is focusing on a case study of the Bangkok Metropolitan Region. The study will provide information and *technical assistance* to Bangkok on the potential impacts of climate change on energy, transportation, water supply and sanitation, public health, and building and housing, and will offer the city a range of adaptation options.

The **Second Beijing Environment** project is an *investment project* with a GEF component aiming to reduce greenhouse gases in a cost-effective and sustained manner by decreasing carbon emission through the conversion of coal-burning, medium-sized boilers to natural gas; by increasing the efficiency of heating systems in buildings by upgrading maintenance and repairs, and by inculcating sound engineering and industry practices.

The **Mekong Transport and Flood Protection** project is another *investment project* that assists Vietnam with the rehabilitation of highways, including increased protection for certain flood-prone segments, and improves efficiency of the regional transport network in the Mekong Delta. The project will create positive externalities in terms of reduced vehicle emissions, which result from shorter travel time due to better maintained and planned roads.

The **Caribbean Catastrophe Risk Insurance Facility** is the first regional disaster insurance facility in the world and allows governments to pool risk and reduce individual premiums. The Facility was created with initial donor *grants* and provides liquidity to countries if hit by a hurricane or an earthquake. A similar initiative is now being developed for the Pacific. Applications at the city level could also be considered.

A *new business line* is under development—**ECO²: Ecological Cities as Economic Cities**. The model will look at a city through an integrated lens of efficient and sustainable spatial planning, transport, energy, water, and institutional capacity issues in an effort to create competitive and livable cities. The framework combines (a) integrated policy, regulatory, and institutional measures (in planning, utility management, and private sector and citizen engagement), (b) coordinated investments in key infrastructure systems, and (c) innovative financing options and incentives for implementation.



Annex D/ Resource Guide

This section provides an illustrative list of references, websites, reports, papers and original documents used in the development of this Primer. Where electronic access is available, this information has been provided.

NATURAL HAZARDS

Author	International Energy Agency (IEA)
Title	<i>World Energy Outlook</i>
Year	2007
Source	http://www.iea.org
Topic	These are detailed reports and up-to-date data on energy in the whole world.

Author	Intergovernmental Panel on Climate Change (IPCC)
Title	<i>Fourth Assessment Report</i> (and previous Reports)
Year	2007 (2001)
Source	http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf
Topic	Reports offer extensive information and data provided about climate change and forecasted impacts.

Author	PEW Center on Global Climate Change
Title	<i>PEW Center Summary of the IPCC Report Working Group III—Summary</i>
Year	2007
Source	http://www.pewclimate.org/global-warming-basics/ipccar4.cfm
Topic	This is a good summary of main results from the IPCC Report.

Author	United Nations Environment Programme (UNEP)
Title	<i>Climate Change Vulnerability and Adaptation in Developing Countries</i>
Year	2007
Source	http://unfccc.int/files/essential_background/background_publications_htmlpdf/application/txt/pub_07_impacts.pdf
Topic	This report discusses details of various adaptation options for different regions of the world.



Author	World Bank
Title	<i>East Asia Environment Monitor: Adapting to Climate Change</i>
Year	2007
Source	http://siteresources.worldbank.org/EXTEAPREGTOPENVIRONMENT/Resources/CGAM_FinalVersion06-19.pdf?resourceurlname=CGAM_FinalVersion06-19.pdf
Topic	This report presents details about expected climate change impacts in East Asia and current approaches to adaptation and financial measures.

DISASTER RISK MANAGEMENT

Author	Abarquez, I. and Murshed, Z.
Title	<i>Community-Based Disaster Risk Management: Field Practitioners' Handbook</i>
Year	2004
Source	Asian Disaster Preparedness Centre
Topic	This handbook was prepared by the Asian Disaster Preparedness Centre (ADPC). ADPC is a nonprofit organization supporting the advancement of safer communities and sustainable development, through implementing programs and projects that reduce the impact of disasters upon countries and communities in Asia and the Pacific.

Author	Economic Commission for Latin America and the Caribbean (ECLAC)
Title	<i>Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters</i>
Year	2003
Source	http://www.eclac.cl/cgi-bin/getProd.asp?xml=/publicaciones/xml/4/12774/P12774.xml&xsl=/mexico/tpl-i/p9f.xsl&base=/mexico/tpl/top-bottom.xsl
Topic	Based on special disaster assessment endeavors since early 1970, ECLAC developed an assessment methodology to estimate the effects of natural disasters.

Author	Gurenko, E. and Lester, R.
Title	<i>Rapid Onset of Natural Disasters: The Role of Financing in Effective Risk Management—Insurance and Contractual Savings Practice</i>
Year	2004
Source	World Bank Policy Research Working Paper 3278, April 2004, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=610323
Topic	Gurenko and Lester provide a conceptual framework for designing a comprehensive risk management strategy for rapid onset natural disasters at the country level, with a particular emphasis on the role of catastrophe-loss funding. The authors discuss the key policy and technical issues involved in building financially sustainable catastrophe risk transfer and funding programs in disaster-prone countries and their links to risk mitigation. They also deal with the cognitive and political economy issues that are likely to arise and ways to accommodate them.



Author	Jackson, J.
Title	<i>Fatal Attraction: Living with Earthquakes, the Growth of Villages into Megacities, and Earthquake Vulnerability in the Modern World</i>
Year	2006
Source	Philosophical Transactions of the Royal Society, 364, 1911–1925
Topic	This paper describes the drastic increase in vulnerability of urban areas, particularly in developing countries due to their rapid population increase.

Author	Pelling, M.
Title	<i>World Disasters Report 2005</i>
Year	2006
Source	International Federation of Red Cross and Red Crescent Societies (IFRC), Geneva, 172–181
Topic	The World Disaster Reports provide the most authoritative data on natural disasters in each country. The information is used worldwide for a large number of purposes, such as to track the disaster trends.

Author	Red Cross/Red Crescent
Title	<i>Climate Guide</i>
Year	2007
Source	http://www.climatecentre.org
Topic	This guide presents five years of experiences from more than 30 Red Cross and Red Crescent National Societies, in particular in developing countries. The Guide relates the experiences of Red Cross/Red Crescent staff and volunteers all around the world trying to understand and address the risks of climate change

Author	Schipper, L. and Pelling, M.
Title	<i>Disaster Risk, Climate Change and International Development: Scope for, and Challenges to, Integration</i>
Year	2006
Source	<i>Disasters</i> , (2006), 30(1), 19–38
Topic	This paper reviews the theoretical and policy linkages among disaster risk reduction, climate change and development. It finds that not only does action within one realm affect capacity for action in the others, but also that there is much that can be learned and shared between realms in order to ensure a move toward a path of integrated and more sustainable development.

Author	Schmidt-Thomé, P.
Title	<i>Integration of Natural Hazards, Risk and Climate Change into Spatial Planning Practices</i>
Year	2006
Source	PhD Thesis, (2006), University of Helsinki
Topic	This thesis describes the current status of instruments for mitigating impacts of natural hazards and climate change, as well as their risks, and the integration of these factors into spatial planning. The thesis highlights the current paradigm shift of climate change mitigation to adaptation and uses this as a basis to draw conclusions and recommendations on what additional concepts could be incorporated into spatial planning practices. Sample multihazard approaches are discussed as an important approach that should be developed further. The thesis cautions that risk concepts are complicated and that their application in spatial planning has to be analyzed carefully.

Author	Sharma, A.
Title	<i>Assessing, Predicting, and Managing Current and Future Variability and Extreme Events and Implications for Sustainable Development</i>
Year	2007
Source	http://unfccc.int/files/adaptation/sbsta_agenda_item_adaptation/application/pdf/background_paper_on_climate_related_risks.pdf
Topic	This is a background paper. UNFCCC workshop on climate-related risks and extreme events under the Nairobi work program on impacts, vulnerability, and adaptation. Related to agriculture, food security, health, and coastal zones.

Author	Van Aalst, M. K.
Title	<i>The Impacts of Climate Change on the Risk of Natural Disasters</i>
Year	2006
Source	<i>Disasters</i> , (2006), 30(1), 5–18
Topic	This paper provides an overview of the relation between climate change and weather extremes, and examines three specific cases where recent acute events have stimulated debate on the potential role of climate change: the European heat-wave of 2003; the risk of inland flooding, such as recently in Central Europe and Great Britain; and the harsh Atlantic hurricane seasons of 2004 and 2005.

HOT SPOTS

Author	Earthquakes and Megacities Initiative
Title	Several papers on urban risk
Year	1998–2000
Source	http://www.emi-megacities.org/
Topic	The Earthquakes and Megacities Initiative (EMI) is an international not-for-profit scientific nongovernmental organization dedicated to the acceleration of earthquake preparedness, mitigation, and recovery of large urban areas (i.e., megacities). EMI serves as a catalyst for the delivery of scientific and technical knowledge to the end-users. EMI focuses its efforts on developing capacity in megacities of the developing world where the effects of earthquakes and other disasters could be devastating to the people, their economy, their culture, and their environment.

Author	Nicholls, R.J.
Title	<i>Coastal Megacities and Climate Change</i>
Year	2006
Source	<i>GeoJournal</i> , 37(3), 369–379
Topic	The paper describes the impact of climate change on the coastal megacities and identifies them as climate change hot-spots. The paper also advocates an integrated approach to coastal management.



Author	United Nations Development Program (UNDP)
Title	<i>The Global Risk Identification Program</i>
Year	2006
Source	http://www.gri-p.net
Topic	The Global Risk Identification Program (GRIP) targets areas of the world where disaster is a major factor in reducing sustainable development. GRIP was launched in June 2007 by UNDP to highlight the importance of disaster risk reduction (DRR) in achieving the Millennium Goals. Its objectives are an improved evidence base for disaster risk management and an increased adoption of risk evidence in disaster risk management and development processes. GRIP's partners are local institutions and governments, UNDP BCPR, the World Bank, the Government of Norway, DFID, USAID, IADB, Munich Re Foundation, UNISDR, Cabinet Office (JP), IFRC, ProVention

Author	World Bank
Title	<i>Natural Disaster Hotspots: A Global Risk Analysis</i>
Year	2006
Source	http://www.proventionconsortium.org/themes/default/pdfs/Hotspots.pdf
Topic	This publication focusing on reducing the risk and social, economic, and environmental impacts of natural hazards on vulnerable populations in developing countries.

Author	World Bank
Title	<i>Natural Disaster Hotspots: Case Studies</i>
Year	2006
Source	http://siteresources.worldbank.org/INTDISMGMT/Resources/0821363328.pdf?resourceurlname=0821363328.pdf and http://geohotspots.worldbank.org/hotspot/hotspots/about.jsp
Topic	This second volume of the Natural Disaster Hotspots project presents a series of case studies undertaken to support the global analysis, published in 2005 as <i>Natural Disaster Hotspots: A Global Risk Analysis</i> . The Hotspots initiative aims to provide information to inform development strategies and investments and to prioritize actions for reducing disaster risk. The initiative began in 2001 under the umbrella of the ProVention Consortium as a collaborative effort of the World Bank, Columbia University's Earth Institute, and a number of international partners.

CLIMATE CHANGE ADAPTATION AND VULNERABILITY

Author	Australian Greenhouse Office
Title	<i>Climate Change: Risk and Vulnerability—Promoting an Efficient Adaptation Response in Australia (Final Report)</i>
Year	2005
Source	http://www.greenhouse.gov.au/impacts/publications/risk-vulnerability.html
Topic	This report explores the risks to Australia from the impacts of climate change over the next 30 to 50 years. Within this, an analysis of comparative risks and their importance for identifying priorities for adaptation action and planning have been discussed.

Author	Baker, J.
Title	<i>Urban Poverty: A Global View</i>
Year	2008
Source	World Bank Urban Paper n.5 January 2008, http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1169585750379/UP-5.pdf
Topic	This paper provides an overview on what has been learned about urban poverty over the past decade with a focus on what is new and what the implications are for the World Bank going forward in an increasingly urbanized world. The chapter on risks includes disaster and environmental risks at the urban level.
Author	Basher, R.
Title	<i>Making Disaster Reduction an Adaptation Policy</i>
Year	2005
Source	Integrated Development and Climate Policies: How to Realize Policies at National and International Levels Workshop, http://developmentfirst.org/Paris/DisasterReduction&AdaptationPolicy_Basher.pdf
Topic	The paper describes the linkage between climate change, increase in vulnerability, and increase in disaster risk.
Author	Dasgupta, S., Laplante B., Meisner C., Wheeler D. and Yan J.
Title	<i>The Impact of Sea-Level Rise on Developing Countries: A Comparative Analysis</i>
Year	2007
Source	World Bank Policy Research Working Paper 4136, www.worldbank.org
Topic	This paper presents a comparative analysis about sea-level rising in different developing countries. The results reveal that hundreds of millions of people in the developing world are likely to be displaced by sea-level rise within this century; accompanying economic and ecological damage will be severe for many. At the country level, results are extremely skewed, with severe impacts limited to a relatively small number of countries. For these countries (e.g., Vietnam, Egypt, and Bahamas), however, the consequences of sea-level rise are potentially catastrophic. For many others, including some of the largest (e.g., China), the absolute magnitudes of potential impacts are very large. At the other extreme, many developing countries experience limited impacts. Among regions, East Asia and Middle East/North Africa exhibit the greatest relative impacts.
Author	Hay, J.E., Warrick, R., Cheatham, C., Manarangi-Trott, T., Konno, J. and Hartley, P.
Title	<i>Climate Proofing: A Risk-Based Approach to Adaptation</i>
Year	2004
Source	Asian Development Bank
Topic	This report describes several case studies of adaptation programs that have been taken up for disaster risk management. The report provides a strong link between disaster risk management and climate change adaptation.



Author	European Environment Agency (EEA)
Title	<i>Vulnerability and adaptation to climate change in Europe</i>
Year	2003
Source	EEA Technical report No 7/2005, ISSN 1725-2237 http://reports.eea.europa.eu/technical_report_2005_1207_144937/en/EEA_Technical_report_7_2005.pdf
Topic	This report provides information on vulnerability in Europe, highlighting the need for adaptation; facilitates information sharing among EEA member countries and learning from ‘best practices in vulnerability assessments and adaptation planning’; contributes to the discussion on adaptation strategies and policies at European Union and national level; and identifies current and future information needs, toward which the EEA and other organizations might be able to contribute.

Author	Huppert, H.E. and Sparks, R.S.J.
Title	<i>Extreme Natural Hazards: Population Growth, Globalization and Environmental Change</i>
Year	2006
Source	Philosophical Transactions of the Royal Society 1875-1888
Topic	The paper focuses on the extremely low-probability events that do not occur more frequently than once in millennia but can have a profound impact on humanity.

Author	J. Feenstra, Burton, I., Smith, J. and Tol, R. (eds.)
Title	<i>Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies</i>
Year	1998
Source	United Nations Environment Programme, Nairobi, and Institute for Environmental Studies, Vrije Universiteit, Amsterdam. (Version 2.0) http://dare.uvu.vu.nl/handle/1871/10440
Topic	The UNEP methodology establishes a generic framework for thinking about and responding to the problems of sea-level rise and climate change. The user goes through the following seven guiding steps: (1) define the problem, (2) select the method, (3) test the method, (4) select scenarios, (5) assess the biogeophysical and socioeconomic impacts, (6) assess the autonomous adjustments, and (7) evaluate adaptation strategies. The last step is itself split into seven substeps. At each step, methods are suggested but the choice is left up to the user.

Author	Kok, M.T.J. and de Coninck, H.C.
Title	<i>Widening the Scope of Policies to Address Climate Change: Directions for Mainstreaming</i>
Year	2007
Source	Environmental Science & Policy, (2007), 587–599
Topic	This paper highlights that both mitigation and adaptation requires coordinated action to be taken by several sections of the society. The paper discusses that improved policy coherence and mainstreaming requires climate policies to go beyond the UNFCCC framework to realize its full potential and to better deal with possible trade-offs.

Author	Mitchell, J.F., Lowe, J., Wood R.A. and Vellinga, M.
Title	<i>Extreme Events due to Human-Induced Climate Change</i>
Year	2006
Source	Philosophical Transactions of the Royal Society, (2006), 364, 2117–2133
Topic	This paper highlights the importance of focusing on extreme events whose frequency may increase due to the impact of climate change.

Author	Morita, K.
Title	<i>Integration of Mitigation and Adaptation Policy Frameworks into the UNFCCC Process</i>
Year	2006
Source	11th Asia Pacific Integrated Model Workshop, Tsukuba, Japan
Topic	The paper discusses how adaptation policies have been dealt within policy and political contexts. The paper also describes the importance of adaptation in the context of developing countries and highlights the role of suitable adaptation at the global level.

Author	Mills, E.
Title	<i>Synergisms between Climate Change Mitigation and Adaptation: An Insurance Perspective</i>
Year	2007
Source	Mitigation and Adaptation Strategies for Global Change, (2007), 12:809–842
Topic	This article reviews the implications of climate change for insurers and provides specific examples of insurance-relevant synergisms between adaptation and mitigation in the buildings and energy sectors, agriculture, forestry, and land use.

Author	Nicholls, R.J, Hanson S., Herweijer C., Patmore N., Hallegatte S., Corfee-Morlot, J. Chateau J., and Muir-Wood, R.
Title	<i>Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes—Exposure Estimates</i>
Year	2007
Source	OECD
Topic	This global screening study makes a first estimate of the exposure of the world's largest port cities to coastal flooding due to storm surge and damage from high winds. This assessment also investigates how climate change is likely to impact each port city's exposure to coastal flooding by the 2070s, alongside subsidence and population growth and urbanization. The study provides a much more comprehensive analysis than earlier assessments, focusing on the 136 port cities around the world that have more than one million inhabitants in 2005. The analysis demonstrates that a large number of people are already exposed to coastal flooding in large port cities. Across all cities, about 40 million people (0.6 percent of the global population or roughly one in 10 of the total port city population in the cities considered here) are exposed to a 1-in-100-year coastal flood event.



Author	Perkins, B., Ojima D. and Corell, R.
Title	<i>A Survey of Climate Change Adaptation Planning</i>
Year	2007
Source	The John Heinz III Center for Science, Economics and the Environment, Washington, D.C. papers, http://www.us-ecosystems.org/NEW_WEB/PDF/Adaptation_Report_October_10_2007.pdf
Topic	The report explores adaptation planning resources available both in the United States and internationally. The report summarizes ongoing efforts to deal with those challenges. Eight existing adaptation plans and 18 adaptation planning efforts with a wide variety of impact areas are reviewed.

Author	Smit, B. (ed.)
Title	<i>Adaptation to Climatic Variability and Change: Report of the Task Force on Climatic Adaptation</i>
Year	2003
Source	Occasional Paper No. 19, Department of Geography, University of Guelph, Ontario, Canada, http://www.climate-adaptation.info
Topic	The report summarizes the results of the studies done by the Task Force on Climatic Adaptation in Canada.

Author	Satterthwaite, D.
Title	<i>Climate Change and Urbanization: Effects and Implications for Urban Governance</i>
Year	2007
Source	United Nations Expert Group Meeting on Population Distribution, Urbanization, Internal Migration And Development—Population Division Department of Economic and Social Affairs, United Nations Secretariat New York, 21-23 January 2008, http://www.un.org/esa/population/meetings/EGM_PopDist/P16_Satterthwaite.pdf
Topic	This paper focuses on the effects of climate change on urban areas in low- and middle-income nations and the implications for urban governance. It emphasizes how most adaptation to the likely climate change-related dangers over the next few decades fit well within a local development agenda.

Author	Smit, B. and Wandel, J.
Title	<i>Adaptation, Adaptive Capacity and Vulnerability</i>
Year	2006
Source	Global Environmental Change, (2006), 16, 282–292
Topic	This paper reviews the concept of adaptation of human communities to global changes, especially climate change, in the context of adaptive capacity and vulnerability. It focuses on scholarship that contributes to practical implementation of adaptations at the community scale.

Author	Srivastava, L. and Heller, T.
Title	<i>Integrating Sustainable Development and Climate Change in AR4</i>
Year	2003
Source	AR4 SCOP-2/Doc. 8, 12.VIII.2003
Topic	This is a preparatory document for the drafting of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Author	United Kingdom Climate Impacts Program (UKCIP)
Title	<i>Climate Adaptation: Risk Uncertainty and Decision Making</i>
Year	2003
Source	http://unfccc.int/files/adaptation/methodologies_for/vulnerability_and_adaptation/application/pdf/united_kingdom_climate_impacts_programme_ukcip_.pdf
Topic	The report proposes a step-wise approach to vulnerability and adaptation assessment in a risk uncertainty decision-making framework. The framework and guidance aim to help decision makers and their advisers in identifying important risk factors and to describing the uncertainty associated with each. It aims to help them judge the significance of the climate change risk compared to the other risks they face, so they can work out what adaptation measures are most appropriate. There are questions for the decision maker to apply at each stage and tools that can be used. The report identifies methods and techniques for risk assessment and forecasting, options appraisal and decision analysis. There are eight stages in the framework: (1) identify problem and objectives, (2) establish decision-making criteria, (3) assess risk, (4) identify options, (5) appraise options, (6) make decision, (7) implement decision, and (8) monitor, evaluate, and review. The framework prescribes a circular process in which feedback and iteration are encouraged and emphasizes a sequential implementation of adaptation measures.

CASE STUDY SOURCES

Author	Agrawal, A.
Title	<i>The Role of Local Institutions in Adaptation to Climate Change</i>
Year	2008
Source	Social Development Department, the World Bank
Topic	The case study focuses on the role of local institutions in adaptation to climate change. It presents a conceptual framework to understand and classify the adaptation practices of the rural poor and the external support. It also includes recommendations on initiatives of local government for adapting to climate change.

Author	City of Cape Town
Title	<i>Framework for Adaptation to Climate Change in the City of Cape Town</i>
Year	2006
Source	http://www.erc.uct.ac.za/publications/Framework%20for%20adaptation%20to%20CC%20in%20the%20city%20of%20Cape%20Town%20-%20FAC4T.pdf
Topic	The report presents an overarching framework for a citywide consolidated and coordinated approach to reducing vulnerability to climate impacts.

Author	Cities Plus
Title	<i>Climate Change Impacts and Adaptation Strategies for Urban Systems in Greater Vancouver</i>
Year	2003
Source	http://www.sheltair.com/library/VOL%202%20citiesplus%20Climate%20Chg%20I%20and%20A%20Strategies%20by%20Urban%20System%20for%20Gr%20Van%20Aug%202003.pdf
Topic	The report presents influence diagrams of potential climate change impacts and illustrative adaptation strategies by urban system for the city of Vancouver.



Author	Clean Air Partnership
Title	<i>Cities Preparing for Climate Change: A Study of 6 Urban Regions</i>
Year	2007
Source	http://adaptation.nrcan.gc.ca/projdb/pdf/171e_e.pdf
Topic	This study incorporates the lessons learned from six early adopters and addresses these experiences by phase of the adaptation planning process

Author	Columbia Earth Institute
Title	<i>Climate Change and a Global City</i>
Year	2001
Source	http://ccsr.columbia.edu/cig/mec/0.1_Front_matter.pdf
Topic	This is a first report on the potential consequences of climate variability and change in the New York Metropolitan Area.

Author	Easterling, W.E., Hurd, B.H. and Smith, J.B.
Title	<i>Coping with Global Climate Change: The Role of Adaptation in the United States</i>
Year	2004
Source	Pew Center papers, http://www.pewclimate.org/global-warming-in-depth/all_reports/adaptation
Topic	This report presents a synthesis of the likely climate change impacts in the United States and the importance of adaptation. Main findings are the following: (a) adaptation is an important complement to GHG mitigation policies, (b) adapting to climate change will not be a smooth or cost-free endeavor, (c) managed systems will fare better than natural systems and some regions will face greater obstacles than others, and (d) proactive approaches to adaptation are more likely to avoid or reduce damages than reactive responses.

Author	He, J.F., Liu, J.Y., Zhuang, D.F., Zhang, W. and Liu, M.L.
Title	<i>Assessing the Effect of Land Use-Land Cover Change on the Change of Urban Heat Island Intensity</i>
Year	2007
Source	<i>Theoretical and Applied Climatology</i> , (2007), 90, 217–226
Topic	This paper presents a discussion on urban heat island effect with particular reference to China.

Author	ICLEI; King County, Washington; Climate Impacts Group
Title	<i>Preparing for Climate Change: A Guidebook for Local, Regional and State Governments</i>
Year	2007
Source	http://cses.washington.edu/cig/fpt/guidebook.shtml
Topic	The report is designed to help local, regional, and state governments prepare for climate change by recommending a detailed, easy-to-understand process for climate change preparedness based on familiar resources and tools. It provides a detailed step-by-step description of the bureaucratic process of constructing and implementing adaptation policy.

Author	International Strategy for Disaster Reduction (UN/ ISDR)
Title	<i>Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters (HFA)</i>
Year	2005
Source	http://www.unisdr.org/eng/hfa/hfa.htm
Topic	The Hyogo Framework for Action was the outcome of the World Conference on Disaster Reduction in Kobe, Hyogo Prefecture, Japan, in January 2005. The details of the conference, including the objectives, expected outcomes, and strategic goals are described in this document. The priorities for action, strategies for implementation and follow-up are also described.
Author	International Strategy for Disaster Reduction (UN/ ISDR)
Title	<i>Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action</i>
Year	2008
Source	(UN/ ISDR-15-2008-Geneva), http://www.unisdr.org/eng/about_isdr/bd-isdr-publications.htm
Topic	This publication helps set priorities for implementing disaster risk reduction, while regularly monitoring and reviewing achievements against clear indicators. It can be used by national authorities, civil society and community organizations, regional inter-governmental institutions, technical bodies, and international and donor communities
Author	International Strategy for Disaster Reduction (UNISDR)
Title	<i>Words Into Action: A Guide for Implementing the Hyogo Framework</i>
Year	2007
Source	http://www.unisdr.org/eng/about_isdr/bd-isdr-publications.htm
Topic	This document was prepared to facilitate consultative processes to develop guidelines and policy tools for each priority area, with relevant national, regional, and international expertise. The Guide describes 22 tasks that are organized to help address and guide the implementation of the Hyogo Framework for Action's five Priorities for Action. Depending on the national situation, the tasks may provide good starting points for organizing action, or useful references against which to check existing policies and procedures. Different users can draw on the parts that are useful to them, adapting the tasks according to their particular needs.
Author	Islami, S., Aramaki, T. and Hanaki, K.
Title	<i>Development and Application of an Integrated Water Balance Model to Study the Sensitivity of the Tokyo Metropolitan Area Water Availability Scenario to Climatic Changes</i>
Year	2005
Source	<i>Water Resources Management</i> , (2005), 19, 423–445
Topic	This paper presents the water availability scenario in the Tokyo Metropolitan Area under future climatic changes. The paper finds that drought risk was observed to be increased significantly for the periods between April–July.



Author	London Climate Change Partnership
Title	<i>Adapting to Climate Change: Lessons from London</i>
Year	2006
Source	Greater London authority, London, http://www.london.gov.uk/climatechangepartnership/docs/adapting-climate-change-london.pdf
Topic	This paper presents 18 city case studies and recommendations from the London Climate Change Partnership. eighteen cities have been examined to understand how they are addressing climate risks that are expected to intensify in London over the coming decades due to climate change, such as flooding, high temperature, and limited water resources.

Author	Matz, N.
Title	<i>Financial Institutions between Effectiveness and Legitimacy—A Legal Analysis of the World Bank, Global Environment Facility and Prototype Carbon Fund</i>
Year	2005
Source	<i>International Environmental Agreements</i> , (2005), 5, 265–302
Topic	This paper presents a legal evaluation of the World Bank’s leadership in climate change issues and analyzes the Global Environment Facility and the Prototype Carbon Fund.

Author	Milan Municipality
Title	<i>Expo 2015: Climate Policies and Programs, (Chapter 16)</i>
Year	2007
Source	http://www.milanoexpo-2015.com/imgup/File/Chapter%2016.pdf
Topic	This article contains all the policies, programs, and strategies on climate change designed for the Expo 2015 bid.

Author	Moser, C. and Satterthwaite, D.
Title	<i>Pro-Poor Climate Change Adaptation in the Urban Centers of Low- and Middle-Income Countries</i>
Year	2008
Source	Social Development Department, the World Bank
Topic	This report explains why urban areas in developing countries are likely to be disproportionately impacted by climate change. It describes the likely consequences of climate change, such as more intense and more frequent natural disasters in urban areas. It also presents the framework for planning adaptation practices for climate change impact and disaster risk management.

Author	New Zealand Climate Change Office
Title	<i>Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand</i>
Year	2008
Source	http://www.mfe.govt.nz/publications/climate/coastal-hazards-may04/coastal-hazards-may04.pdf
Topic	This Guidance Manual is intended to help local authorities manage coastal hazards by (1) providing information on the effects of climate change on coastal hazards; (2) presenting a decision-making framework to assess the associated risks; and (3) providing guidance on appropriate response options.

Author	Rosenzweig C., Major, D., Demong, K., Stanton, C., Horton, R. and Stults, M.
Title	<i>Managing Climate Change Risks in New York City's Water System: Assessment and Adaptation Planning</i>
Year	2007
Source	<i>Mitigation and Adaptation Strategies for Global Change</i> (2007) 12:1391–1409 DOI 10.1007/s11027-006-9070-5
Topic	This report describes the climate risk management framework that the New York City Department of Environmental Protection (NYCDEP), the agency responsible for managing New York City's water supply, sewer, and wastewater treatment systems, has developed through its Climate Change Task Force. It is a government-university collaborative effort.
Author	Schibel, K.L. and Guerrieri, M.
Title	<i>Adaptation and Mitigation: An Integrated Climate Policy Approach—Report on the Mitigation Scan City of Venice</i>
Year	2006
Source	http://www.amica-climate.net
Topic	This report presents the framework and the application results of the Mitigation Scan done for the City of Venice. It is part of the AMICA Project, partially-financed by the European Union.
Author	Shaw, R., Colley, M. and Connell, R.
Title	<i>Climate Change Adaptation by Design: A Guide for Sustainable Communities</i>
Year	2007
Source	TCPA, London, http://www.tcpa.org.uk/downloads/20070523_CCA_lowres.pdf
Topic	This report presents the expected climatic change in the United Kingdom (UK) and the different adaptation options for the UK due to the scenarios of climate change.
Author	Stern, N.
Title	<i>Stern Review on the Economics of Climate Change</i>
Year	2006
Source	http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_Report.cfm
Topic	This Review focuses on the impacts and risks arising from uncontrolled climate change, and on the costs and opportunities associated with action to tackle it. The Review finds that all countries will be affected by climate change, but it is the poorest countries that will suffer earliest and most. The Review also examines the national and international policy challenges of moving to a low-carbon global economy.
Author	Tyndall Centre for Climate Change Research
Title	<i>Surviving Climate Change in Small Islands: A Guidebook</i>
Year	2005
Source	http://www.tyndall.ac.uk/publications/surviving.pdf
Topic	The Tyndall Centre for Climate Change Research has produced the booklet to discuss what lies ahead for the Pacific and what might be done. It is a practical guide that explains in layman's terms the threats, risks, and opportunities open to us in the Pacific, the first to be seriously threatened by climate change. The booklet contains sections on vulnerability assessment and adaptation plan development as well as an entire chapter on implementation.

Author	United Nations Development Program (UNDP)
Title	<i>Reducing Disaster Risk: A Challenge for Development</i>
Year	2004
Source	http://www.undp.org/cpr/disred/rdr.htm
Topic	This Report is premised on the belief that in many countries the process of development itself has a huge impact—both positive and negative—on disaster risk. It shows how countries that face similar patterns of natural hazards—from floods to droughts—often experience widely differing impacts when disasters occur. The impact depends in large part on the kind of development choices countries have made previously. This Report introduces a pioneering Disaster Risk Index (DRI) that measures the relative vulnerability of countries to three key natural hazards—earthquake, tropical cyclone, and flood—identifies development factors that contribute to risk, and shows in quantitative terms, just how the effects of disasters can be either reduced or exacerbated by policy choices.

Author	United Nations Environment Program (UNEP)
Title	<i>Vulnerability Indices for Planning Climate Change Adaptation</i>
Year	2006
Source	Training Workshop on National Adaptation Programme of Action (NAPA), http://www.unitar.org/ccp/samoa/UNEP%20VA%20Indices.pdf
Topic	This presentation provides the links between science and policy in adaptation and the referees for a protocol for vulnerability assessment.

Author	Viner, D. and Bouwer, L.
Title	<i>Linking Climate Change Adaptation and Disaster Risk Management for Sustainable Poverty Reduction</i>
Year	2006
Source	Vietnam Country Study, EU funded, 2006, Ref. MWH 475000177.001-4
Topic	This paper includes detailed information about Disaster Management System in Vietnam.

Author	Wisner, B.
Title	<i>At Risk: Natural Hazards, People's Vulnerability and Disasters</i> (2nd Ed.)
Year	2004
Source	Routledge
Topic	This book presents a very detailed in-depth discussion on the various factors that lead to a disaster, including the hazard, vulnerability and resilience. The book also discusses the coping mechanisms. The factors and actions that may reduce the severity of disasters are also described. The various international agreements and frameworks and their implications are also discussed.

Author	Yuen, B.
Title	<i>Squatters No More: Singapore Social Housing</i>
Year	2007
Source	<i>Global Urban Development</i> , (2007), 3, 1–22
Topic	This paper presents a detailed analysis of the social housing policy of Singapore since its independence. The paper highlights the importance of a holistic approach that has resulted in virtually no squatter population in Singapore.



CITY PROGRAMS (SOUND PRACTICE)

City	Albuquerque
Program	Albuquerque Climate Change Programs
Source	http://www.cabq.gov/sustainability
City	Albuquerque
Program	Albuquerque Green Programs Tools and Goals
Source	http://www.albuquerquegreen.com
City	Albuquerque
Program	Local Government Leadership and Tools
Source	http://www.coolmayors.org/common/11061/default.cfm?clientID=11061
City	Albuquerque
Program	Albuquerque Emergency Management
Source	http://www.cabq.gov/emergency
City	Hanoi
Program	On disaster management system in place
Source	http://www.aprsaf.org/text/wg_vietnam_info.html
City	Hanoi
Program	On disaster management system in Vietnam and in the Nam Dinh Province
Source	www.climatevarg.org/essd/env/varg.nsf
City	Jakarta
Program	PEACE. 2007. Indonesia and Climate Change: Current Status and Policies
Source	www.peace.co.id
City	Jakarta
Program	National Action Plan for Disaster Reduction 2006–2009.
Source	http://www.undp.or.id/press/view.asp?FileID=20070124-1&lang=en
City	Milan
Program	About EcoPass
Source	http://www.comune.milano.it/dserver/ecopass/index.html
City	Milan
Program	About Milan Expo 2015 bid
Source	http://www.milanoexpo-2015.com/



City	Milan
Program	About emissions inventory
Source	http://www.epa.gov/ttn/chief/conference/ci13/poster/caserini.pdf
City	New York City
Program	Climate change information about the New York Metropolitan area
Source	http://ccir.ciesin.columbia.edu/nyc/index.html
City	New York City
Program	Impacts of climate change in the New York Metropolitan area
Source	http://www.climatehotmap.org/impacts/metroeastcoast.html
City	New York City
Program	C40 Large Cities Summit on Climate Change, held in New York in 2007
Source	http://www.nycclimatesummit.com/
City	Rockville, Maryland
Program	Municipal government
Source	http://www.rockvillemd.gov/environment/sustainability/
City	Seattle, King County
Program	The Benchmark Report
Source	http://www.metrokc.gov/budget/benchmrk/
City	Seattle, King County
Program	Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments
Source	http://cses.washington.edu/cig/fpt/guidebook.shtml
City	Seattle, King County
Program	The 2006 Annual Growth Report: King County, Washington
Source	http://www.metrokc.gov/budget/agr/agr06/
City	Seattle, King County
Program	2007 King County Climate Plan
Source	www.metrokc.gov/exec/news/2007/pdf/climateplan.pdf
City	Seattle, King County
Program	Map Your Neighborhood Discussion Guide Washington State Emergency Management
Source	http://emd.wa.gov/myn/myn_organize.shtml
City	Seattle, King County
Program	Seattle All-Hazards Mitigation Plan, City of Seattle
Source	http://www.seattle.gov/emergency/



City	Seattle, King County
Program	Hazard Identification and Vulnerability Analysis, City of Seattle
Source	http://www.redmond.gov/insidecityhall/planning/mitigation/pdfs/hiva.pdf
City	Seattle, King County
Program	The Green Ribbon Commission Report
Source	http://www.seattle.gov/climate/report.htm
City	Seattle, King County, Washington
Program	King County Emergency Management
Source	www.kingcounty.gov/prepare
City	Singapore
Program	<i>The Singapore Green Plan 2012 (2006 Edition)</i> , Ministry of Environment and Water Resources, Government of Singapore (2006)
Source	www.mewr.gov.sg/sgp2012
City	Singapore
Program	Energy for Growth: National Energy Policy Report (2007)
Source	app.mti.gov.sg/default.asp?id=2546
City	Singapore
Program	Singapore National Climate Change Strategy (2007)
Source	http://www-gio.nies.go.jp/wwd/wgia/wg4/pdf/3_I_02_Wong_Singapore.pdf
City	Singapore
Program	<i>Singapore—Beyond Clean & Green, Toward Environmental Sustainability</i> , Ministry of Environment (2004)
Source	www.env.gov.sg
City	Singapore
Program	Ministry of Home Affairs
Source	http://www.mha.gov.sg
City	Tokyo
Program	Tokyo Climate Change Strategy, Tokyo Metropolitan Government (2007)
Source	www2.kankyo.metro.tokyo.jp/kikaku/kikouhendouhousin/data/ClimateChangeStrategyPress.pdf
City	Tokyo
Program	Tokyo 2020 Renewable Energy Strategy, Tokyo Metropolitan Government (2006)
Source	www2.kankyo.metro.tokyo.jp/kouhou/env/english/pdf/Tokyo%20Renewable%20Energy%20Strategy.pdf



City	Tokyo
Program	Urban Development Program—Tokyo Metropolitan Government
Source	www.metro.tokyo.jp and www.toshiseibi.metro.tokyo.jp

City	Venice
Program	Overviews of the Vulnerability of Venice to the Impacts of Climate Change and Sea-Level Rise, several papers
Source	www.feem.it

City	Venice
Program	On mitigation and adaptation specific activities
Source	http://www.amica-climate.net/





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Contents of CD-ROM

The CD-ROM included at the back of this Primer includes:

- An electronic version of this Primer;
- 13 City Profiles;
- Agenda, presentations, and materials from the Makati Consultation Workshop (May 2008);
- Presentations and materials from the Green Cities Launch Workshop (July 2008); and
- Selected World Bank and UN reference documents from those listed in Annex D.

These are discussed below.

A/ CITY PROFILES

City Profiles of Sound Practice on CD-ROM accompany the Primer. This section gives a brief summary of the City Profiles and explanation of why the cities were selected for their efforts at addressing climate change impacts, consequences, and disaster risk management issues. The City Profiles on CD-ROM offer a more detailed presentation of the cities' initiatives, projects, and programs.

There are two types of City Profiles on the CD-ROM—long and short. The long profiles include a comprehensive analysis of a city's disaster management systems, and of climate change impacts. The short profiles are those that focus on a selected aspect of a city's climate and disaster management path, which has been highlighted, i.e., adaptation to climate change, mitigation of climate change impacts, or mitigation of disaster risks. A list of the Profiles and a brief introduction of each follows below.

LONG PROFILES include analysis of the following city programs:

- Albuquerque, New Mexico, USA;
- Jakarta, Indonesia;
- King County/Seattle, Washington, USA;
- Rockville, Maryland, USA;
- Singapore; and
- Tokyo, Japan.



Albuquerque, New Mexico, USA

Albuquerque is a high desert environment where secure and safe water is among the most important issues facing society. To assure water quantity and quality and to gain the support of citizens through behavioral change to become responsible water users are among the city's priorities. The Profile illustrates the relationships between the cause and effects of global warming and hazard management and how those impacts relate to and translate into actions that can and need to be coordinated and implemented.

The Albuquerque Climate Change Impacts and Disaster Risk Management programs are managed through the Sustainability Office of the city government and the different departments that form the climate change team and the Office of Emergency Management. Albuquerque has identified a set of priorities based on its learning and its association with local, national, and international organizations to determine a way forward.

This Profile presents an overview of Albuquerque's comprehensive approach, financing mechanisms, strategy development process, and accomplishments from information presented on the Albuquerque Web page that links to detailed explanation of what the city has achieved. The Profile presents information that documents and explains Albuquerque's vulnerabilities and the impacts it foresees in the near and long term, commitments to understand and respond to those changes, and Albuquerque's accomplishments to date.

The Albuquerque Profile focuses on the activity-based structure of its strategy, which includes:

- Efforts to secure a safe water supply;
- Greenhouse gas reduction;
- Renewable energy and biofuels;
- Urban forestry;
- Alternative transportation;
- Waste reduction and recycling;
- Energy conservation;
- Green building; and
- Partnerships and collaboration (emergency operations, community volunteers, and responsibilities and disaster risk management).

Albuquerque also follows a “no-regrets” approach to good urban management of limited and non-renewable resources. As Albuquerque Mayor Martin J. Chávez stated clearly, “We have to walk the walk,” meaning that change starts with the way the city manages itself. The city becomes the example of change and the resources needed to build in efficiencies and new technologies to reduce global warming and the hazards it may affect. Albuquerque rightfully advertises its comprehensive program.

The hazards that threaten Albuquerque, as presented in the Profile, include floods, fires, water security, drought, and extreme weather events including ice storms, heavy snows, and flash floods. To confront these hazards, the Office of Emergency Management was established. Climate change impacts may create more frequent and more intense events such as wildfires and flashfloods, harsher winters with more snow, and erratic precipitation patterns that may create water security and more

frequent disasters. The Profile highlights the local government structure that could build closer relations between the Office of Emergency Management and the Sustainability Office. One of the most interesting priorities established in Albuquerque for emergency management is the role of the community and the “neighbor-helping-neighbor” approach. This is a critical part of the all-hazards approach the Office of Emergency Management carries out and could work as well for the climate change impact efforts.

Jakarta, Indonesia

Jakarta, with a population of around 12 million and experiencing very rapid growth, is one of the largest cities in East Asia and is very vulnerable to several climate change-related hazards. The city has great sensitivity to the impact of climate change, particularly since 40 percent of the city sits below sea level. The city is also experiencing subsidence that may further lower the ground level of several parts of the city that are currently above sea level.

There are 13 rivers that pass through the province, of which 3 are inter-provincial rivers. The inter-provincial rivers are controlled by the Central Government, while the local rivers are controlled by the provincial government. Jakarta therefore experiences complex coordination in river management during intense rainfalls.

Jakarta has also experienced extensive loss of urban greenery that has magnified the problems with the urban heat island effect. This has contributed to other secondary undesirable effects such as increasing air-conditioning use and energy demand.

Jakarta has undertaken some adaptation and mitigation programs in the transportation sector. Some major arterial roads have been classified as three-in-one during peak hours wherein only vehicles with at least three occupants are allowed on these streets. The three-in-one system is strictly enforced and has a salutary effect in modifying the driving habits of the residents. The city has implemented a rapid bus transit system and has constructed dedicated public transport corridors on several arterial roads to encourage greater use of public transportation. The rapid bus transit vehicles have low emissions and are operated at very frequent intervals. The city is currently planning to include more roads under the rapid bus transit system.

King County/Seattle, Washington, USA

King County/Seattle is a coastal environment sitting on a fault line that makes it vulnerable to not only sea-rise and extreme events, storm surges, and floods, but also earthquakes. This Profile is included for its comprehensive approach and program that may be a useful model to other cities now embarking on an active program to deal with climate change impacts and disaster risk management. The Profile has been organized into priority areas including:

- Making commitments;
- Team building;
- Learning;
- Developing strategies;
- Priorities setting; and
- Actions programs.

Especially important to the learning element is the working relationship with the University of Washington as its technical advisor.

The management of the climate change impacts and disaster risk management program is a joint effort of the King County Climate Change team comprised of key departments of the county government and the Sustainability Office of Seattle and its Office of Emergency Management. Based on work of the scientific support team at the University of Washington, climate change impacts were identified and presented in the 2007 King County Climate Change Plan and Seattle's Hazard Identification and Vulnerability Analysis. Knowledge of the projections became the basis for the plans that were developed and presented in the Profile.

King County expresses its proactive approach in its outreach and program materials it has developed to create consensus. The Profile is organized to present a snapshot of the King County and Seattle context. Both jurisdictions have prepared extensive information that documents and explains their vulnerabilities and the impacts they foresee coming in the near and long term, their commitments to understand and do something about those changes, what they identified to do, and how they will accomplish their plans as well as their accomplishments to date.

The Profile presents information from their documents selected to illustrate the relationships between the cause and effects of global warming and how those impacts relate to and translate into actions that can and need to be taken. The approach is a “no-regrets” approach that addresses the issues identified as good urban management. The approach is comprised of four priority areas of climate change impacts and issues:

- **Transportation choices.** King County's biggest source of GHG emissions is the transportation sector. Goal: Achieve by 2050 a climate stabilization target in government operations by reducing GHG emissions 80 percent below current levels.
- **Buildings and land use.** Goal: Ensure efficient landuse and development by densifying designated urban growth areas to make communities more “walkable” and healthier and ultimately encourage people to drive less. In addition, it aims to protect the historic built environment, agricultural land, forestry, and open spaces as ecological buffers against global warming impacts by planning for and investing in major public works projects, including storm-water management, wastewater operations, and regional wastewater and reclamation service plans to protect marine and freshwater quality and to enhance the regional freshwater supply.
- **Environmental management.** Goal: Protect health, safety, and landscape from global warming impacts and related natural resource supply emergencies and threats, especially water; and capture methane emissions from landfills and sequester CO₂ emissions in forests through adaptation programs for public health and emergency preparedness to cope with severe climate events, flood hazards, drought, new diseases, and extreme heat.
- **Renewable energy.** Goal: Target the use of renewal energy resources in 50 percent of nontransit energy use by 2012 and 50 percent of transit fuel by 2020; be a market catalyst for increased use and availability of renewable energy resources; cut pollution; and reduce dependence on foreign oil.

Rockville, Maryland, USA

The Rockville Profile is included for its illustrative near-term set of activities that can initiate a program and build credibility for the city and confidence in the Rockville Team implementing it. Rockville is a small, inland town and part of the greater Washington, D.C. region.

This Profile highlights elements of the Strategy for a Sustainable Rockville (October 1, 2007).⁵³ What it offers is the opportunity to examine the goals and examples of a smaller town, with an estimated population of 53,710 (2005), and yet see that the issues and the solutions are similar. Climate change impacts are the result of an accumulation of effects from cities small and large alike. Though part of the greater Washington, D.C., area, Rockville has its own jurisdiction and responsibility for its climate change and hazard management programs. Consistent with other profiled U.S. cities, sustainability and emergency management are considered separate issues and dealt with by separate offices.

This Rockville strategy describes a significant number of actions that will move it closer to sustainability over the next one to three years. These examples represent Rockville's first steps and may serve as a reference for other cities just beginning to address similar issues. Important also is the identification of the lead city department(s) for each initiative:

- Air Quality, Noise, and Transportation;
- Environmentally Sensitive Development;
- Interdepartmental and Interagency Collaboration;
- Environmentally Preferable Purchasing and Contracting;
- Public Dialogue, Education, and Outreach;
- Natural Resources Stewardship;
- Water Protection and Conservation;
- Waste Minimization, Reuse, and Recycling;
- Energy and Climate Protection; and
- Community Aesthetics.

Singapore

Singapore is a large, highly dense coastal city with an estimated population of 4.59 million (2007). Singapore is highly vulnerable to hydro-meteorological disasters, rise in sea level, and transborder air pollution hazards. The city is also susceptible to teleseismic events. The Profile of Singapore has been included as a comprehensive description of the approach to disaster risk management and climate change in the city. The Profile provides information on the institutional mechanism and may assist other cities in initiating their climate change programs. The city recognizes the importance of involving all stakeholders to respond to climate change and has involved them in various platforms to ensure smooth implementation of the strategy.

The Singapore Profile describes in detail the environmental policy that was started to address some specific environmental hazard problems. The transition of these programs to climate change strategy is also described in detail. The Singapore Climate Change Strategy sets out how Singapore will address the various aspects of climate change by better understanding our vulnerabilities to climate change, identifying and assessing adaptation measures required for climate change, and mitigating GHG emissions.

In consultation with various government agencies, the Singapore National Environmental Agency, which has been designated as the nodal agency for climate change program, has commissioned a study of Singapore's vulnerability to climate change. These studies will assess the local and regional impacts and improve the resolution of the global assessment results such as the IPCC reports that are currently used. The studies are expected to better inform the various adaptation efforts and are expected to be completed by 2009.

The city has initially adopted a “no-regrets” approach focusing on mitigation and adaptation opportunities that are generally beneficial to clean environment and good urban governance. The city is in the process of initiating several mitigation programs aimed at controlling the extent of GHG emissions and aims to establish itself as a regional hub for economic activities in the field of carbon trading. As a part of the “no-regrets” approach, Singapore has identified improving energy efficiency as its key strategy for mitigating GHG emissions. Energy efficiency will not only reduce GHG emissions but also reduce the cost of living and doing business as well as enhance energy security. Therefore, with regard to the industry, buildings, households, and transport sectors, the government will actively support energy users to be more energy efficient through incentives and through regulations to provide consumer information and deploy appropriate technologies. The examples of the various mitigation and adaptation initiatives illustrate the institutional mechanism and implementation system that are required and their financial and regulatory framework.

Tokyo, Japan

Tokyo, the capital of Japan, is the most populous urban agglomeration in the world (consisting of Tokyo metropolitan region and adjoining urban areas) with a population of over 25 million, out of which the Tokyo metropolitan region has around 12.54 million. Tokyo has very high risk of earthquakes, tsunami, and typhoons. The last major earthquake in 1923 resulted in the deaths of over 141,000 people.

Tokyo is also one of world's largest industrial hubs. A major disaster could have global dimensions and could result in economic impact around the world. Therefore, protecting people's lives and property from disasters and keeping social assets safe are the basic issues for the development of the metropolis. The city has therefore provided strong emphasis on both disaster risk management and climate change impacts management as an overarching component of urban governance.

The Tokyo Climate Change Strategy is far more ambitious in its objectives and scope than Japan's commitment under Kyoto Protocol. The Profile describes the Tokyo Climate Change Strategy, a basic policy for the “10-Year Project for a Carbon-Minus Tokyo” launched in January 2007. The Profile includes the basic framework of climate change mitigation strategies that Tokyo Metropolitan Government intends to carry out over the next ten years. Representative measures from its 10-year project designed to cope with climate change are included in the Tokyo Profile:

- Review how energy should be used in cities, resulting in a shift toward a low-CO₂, low-energy society that allows people to lead an affluent, comfortable, urban life while minimizing energy use;
- Optimize the use of energy with respect to demand but with renewable energy sources such as solar and unutilized urban waste heat, thereby enhancing Tokyoites' energy independence;
- Push forward the passive use of energy that uses natural light, wind, and heat; and “green”



architecture that builds in performance and relationship between other buildings, structures, greenery, and local microclimate; and

- Create a new urban-style business through the development and subsequent spread of low-CO₂ social systems and technologies.

SHORT PROFILES include analysis of the following city programs:

- Dongtan, China;
- Hanoi, Vietnam;
- London, England, United Kingdom;
- Makati City, Metro Manila, Philippines;
- Milan, Italy;
- New York, New York, USA; and
- Venice, Italy.

Dongtan, China (The Chinese Eco-city)

China is experimenting with the development of Chongming Island as the location of Dongtan to be home to 500,000 by 2050. Dongtan aims to be the world's first purpose-built eco-city. The city is designed not only to be environmentally sustainable, but also socially, economically, and culturally sustainable. Its goal is to be as close to carbon neutral as possible, with city vehicles that produce no carbon or particulate emissions and with highly efficient water and energy systems. Dongtan will generate all of its energy needs from renewable sources, including biofuels, wind farms, and photovoltaic panels. Most of Dongtan's waste will be reused as biofuel for additional energy production, and organic waste will be composted. Even human sewage will be composted and processed for energy and composting, greatly reducing or entirely eliminating landfill waste sites.

Dongtan is located on Chongming Island at the mouth of the Yangtze River. The site is situated on 8,600 hectares (86 square kilometers or 21,250 acres) of agricultural land; it is adjacent to a wetland of international importance, and the city design incorporates a 350 hectare (3.5 square kilometers or 865 acre) buffer zone between the city and the wetland to minimize the impact of the development. The developed city will eventually cover just 40 percent of the total site area, with the remaining land used for agriculture and energy production, or returned to a wetland state.

The Shanghai Government is constructing a bridge and tunnel linking Chongming Island to the center of Shanghai. SIIC (Shanghai Industrial Investment Corp.), the largest international investment group company owned by the Shanghai municipal government, is developing the site. The city will be completed in three phases. Phase 1: one square kilometer (100 hectares or 250 acres) will be developed to accommodate up to 10,000 people by 2010. Phase 2: 6.5 square kilometers (650 hectares or 1,600 acres) will be developed to accommodate 80,000 people by 2020. Phase 3: 30 square kilometers (3,000 hectares or 7,415 acres) will be developed to accommodate 500,000 people by 2050.

The social sustainability plan includes integrating the current population (a small fishing community and agricultural workers) into the city design rather than displacing them. The strategy for attracting and determining who will make up the additional population and how they will move into Dongtan is

still being developed; however, in order to be socially sustainable, the population will need to come from a wide range of socio-economic backgrounds, as there will be jobs for every person able to work.

Hanoi, Vietnam

Hanoi is included in the Profiles because of its flood control programs. Hanoi is a medium-sized city that sits on the Red River. It is prone to increased flooding events. Applications for flood prevention and inundation preparedness, challenges and risks, and disaster management system coordination are listed in the Profile. The Profile also includes information about the Nam Dinh Province more broadly.

London, England, United Kingdom

London is included in the Profiles because of its mitigation and adaptation policies. The CD-ROM does not present all the measures, actions, and policies defined by London, but focuses on certain activities of much interest for cities in East Asia.

On the mitigation side, the London Low Emission Zone (LEZ) aims to improve air quality in the city by deterring the most-polluting vehicles from driving in the area. The vehicles affected by the LEZ are older diesel-engine lorries, buses, coaches, large vans, minibuses, and other heavy vehicles that are derived from lorries and vans, such as motor caravans and motorized horse boxes. Cars and motorcycles are not affected by the scheme. The LEZ commenced on February 4, 2008, for trucks over 12 tons, with different vehicles affected over time; tougher emissions standards are planned to be introduced in January 2012.

The adaptation strategy is based on risk management, and the idea that adapting to climate change impacts doesn't involve much that is outside of the normal purview of operations, and mostly focuses on "no regrets" policies. Major areas of the adaptation strategy plan are drought (water supply), flooding, and temperature increases; also air quality, economic, winter storm severity (extreme weather events), transportation.

The groundwork for the adaptation plan has been laid through several reports, including "London's Warming" (2002), "Climate Change and London's Transport Systems" (2005), and "Adapting to Climate Change: Lessons for London" (2006), all available from the city web site. The adaptation strategy for London is and will be a city strategy which will seek to mainstream climate issues through the Greater London Authority. Flooding, drought, and temperature increases are the main focus of the strategy, but other impacts such as air quality and winter storm severity will be addressed as well. An additional focus will be climate change events that occur outside of London itself, but have impacts in the city because the city serves as the country's financial center.

Makati City, Metro Manila, Philippines

Makati City is a part of Metro Manila and is considered to be the economic, political, and cultural capital of the Philippines. It is the most prosperous city in the country with its Human Development Index (HDI) approaching the HDI of Japan. The city experiences high seismic hazard and is also highly prone to hydro-meteorological and environmental disasters. Makati City has set up strong institutional mechanisms for facilitating action on climate change and disaster risk management. The city has set up the Makati City Disaster Coordination Council (MCDCC) as the apex body for planning disaster



risk management efforts in the city. The city has also set up the Makati City Environmental Protection Council (MCEPC) as the apex body for planning environmental and climate change management in the city. The Profile of Makati City includes a brief description of the city's demographic details.

Makati City has set up a strong institutional system for disaster risk management as well as climate change. The MCDCC has representation of all relevant departments of the national and city governments, in addition to the MCEPC. Similarly, the MCEPC has representation of all relevant departments of the national and city governments, in addition to the MCDCC. The institutional structure of these two bodies facilitates coordinated planning and also ensures that the cross-cutting issues are fully dealt with the two Councils.

The Makati City Profile describes the various salient initiatives on disaster risk management and climate change management. The climate change management strategy includes very ambitious targets for reduction of GHGs.

Milan, Italy

Milan is included in the Profiles because of its mitigation policies. Milan is a large, inland industrial city that developed an extensive climate change strategy, designed an innovative campaign to reduce congestion and pollution (Ecopass), and will host Expo 2015. For this important event, an extensive climate change management program has been initiated, which includes offset programs and carbon finance instruments application, as well as partnering and twinning with other cities in developing countries.

Milan is committed to drastically reducing its emissions; using the year 2000 as a reference point, it plans to cut them by 15 percent by 2012 and 20 percent by 2020. Milan's climate program focuses on cutting emissions from residential energy use and transport, yet it is also based on a programmatic approach that takes into account all the factors of producing, collecting, and absorbing emissions.

The city of Milan is promoting its own climate program specifically for Expo 2015. Milan intends to reduce emissions generated during the preparation, staging, and aftermath of the event. The broader targets of this program are to propose new mechanisms and projects to generate emission credits, attract ideas, and export the best technologies or sound practices and skills to other countries. The city of Milan is promoting new initiatives compatible with the Kyoto Protocol (carbon financing schemes) to design and test genuine applications to be shared and implemented jointly with other European cities and developing countries.

New York City, New York, USA

New York City has one of the most urbanized coastlines in the United States, making it particularly vulnerable to sea-level rise. New York City has developed an extensive and detailed program to combat climate change impacts: The Climate Change Action Plan includes both mitigation and adaptation. It includes a GHG inventory and is built on a comprehensive study of its vulnerabilities and climate change impact projections. The municipality-run program operates in partnership with specific agencies, Columbia University, NASA, and other competent offices. New York City also developed a consultation program called "stakeholder interactive approach."

New York City has been profiled for its governance system. The recently introduced long-term Planning and Sustainability Office is leading the climate change adaptation strategy and is linked to other agencies in the city and to other departments, such as Environmental Protection and Buildings.

Venice, Italy

The lagoon of Venice is an environment undergoing constant remodeling due to erosion, sediment movement, human activity, and the effects of GHG emissions. In addition, global warming will produce a change in the local thermo conditions (in the next 50 years a rise in temperature of 0.7–4.1°C is foreseen for the Upper Adriatic (IPCC 2001)) and therefore in the currents.

In the last century, Venice sank 11 inches, mostly due to the pumping of groundwater and methane gas for local industries. But it is also affected by rising sea levels. The same tides that did not flood the city 100 years ago are now high tide events, or *acqua alta*. High water afflicts Venice mostly in the winter. A century ago, it happened 7 times a year, now it is more like 100 times. Venice is facing at least two significant challenges: city infrastructure, historical buildings, and homes must be saved; and the lagoon and its wetlands must be protected.

Venice manages its climate change impacts and disaster risk management programs through several mitigation and adaptation activities. The most quoted is certainly the approved plan to protect Venice, called MOSE (*Modulo Sperimentale Elettromeccanico*, or Experimental Electromechanical Module).

B/ CONSULTATION WORKSHOP PRESENTATIONS

A stakeholder consultation workshop was held in Makati City, Philippines, in May 2008 to discuss the Primer with cities across East Asia and to receive their feedback in the finalization of the document. The CD-ROM includes the final agenda from the workshop, plenary presentations made by various speakers (including a World Bank presentation on the contents of the Primer), and presentations made by break-out groups at the workshop on various aspects of the Primer such as the City Profiles, the Hot Spots exercise, overall usability, the links in the Primer between climate change and disaster risk management, and the general value added of the Primer beyond other resources already available.

C/ GREEN CITIES LAUNCH WORKSHOP

A global launch of the Primer was held in Pattaya, Thailand, on July 14, 2008, in collaboration with the United Cities and Local Governments Asia Pacific Congress (UCLG ASPAC). The CD-ROM includes presentations on Thailand, New York City, Singapore, London, Seattle, Incheon, Milan, and Makati, in addition to a presentation on the final Primer, a proceedings document on the workshop, a final agenda, and speaker bios.

D/ WORLD BANK RESOURCE DOCUMENTS

The CD-ROM also includes selected World Bank and UN reference documents, referred to in Annex D, Resource Guide.



Glossary

Adaptation. Adaptation is an adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderate harm or exploit beneficial opportunities. Various types of Adaptation can be distinguished, including anticipatory and reactive Adaptation, private and public Adaptation, and autonomous and planned Adaptation. Anticipatory Adaptation—Adaptation that takes place before impacts of climate change are observed. Also referred to as proactive Adaptation. Autonomous Adaptation—Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Autonomous Adaptation is also referred to as spontaneous Adaptation. Planned Adaptation—Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

Climate. Climate in a narrow sense is usually defined as the “average weather,” or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization. One popular phrase can help distinguish weather from climate: “Climate is what you expect. Weather is what you get.”

Climate change. Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines “climate change” as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” See also *climate variability*.

This glossary builds on definitions provided by sources including the Intergovernmental Panel on Climate Change Fourth Assessment Report, the International Federation of Red Cross and Red Crescent Societies, the United Nations Development Program/Global Environment Facility Adaptation Policy Frameworks, the United Nations International Strategy for Disaster Reduction, and the World Bank. Definitions have been shortened or adjusted to meet Primer requirements.



Climate risk management. An approach to systematically manage climate-related risks affecting activities, strategies, or investments, by taking account of the risk of current variability and extremes in weather as well as long-term climate change.

Climate variability. Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also *climate change*.

Coastal erosion. Landward movement of the shoreline due to the forces of waves and currents. Coastal erosion can get worse due to sea-level rise and more intense storms associated with climate change.

Community-based disaster risk management. A process that seeks to develop and implement strategies and activities for disaster preparedness (and often risk reduction) that are locally appropriate and locally “owned.”

Complex disaster. A disaster that has no single root cause (such as a storm) but emerges due to a combination of factors, which may involve an extreme weather event, conflict and/or migration, environmental degradation, and other issues. Complex disasters are becoming more likely due to climate change, which may alter hazards and amplify underlying vulnerabilities.

Cyclone. See *tropical cyclone*.

Density. The number of people, dwellings, or the like, per unit area. Population density is often specified as the number of people per hectare of land area or per square kilometer of land area.

Disaster. A situation in which the impact of a hazard (such as a storm or other extreme weather event) negatively affects vulnerable individuals or communities, to a degree that their lives are directly threatened or sufficient harm is done to economic and social structures to undermine their ability to survive or recover.

Disaster (risk) management. A systematic process of implementing policies, strategies, and measures to reduce the impacts of natural hazards and related environmental and technological disasters. This includes, among other things, disaster risk reduction, preparedness, response, recovery, and rehabilitation.

Disaster preparedness. Activities that contribute to the pre-planned, timely, and effective response of individuals and communities to reduce the impact and deal with the consequences of a (future) disaster.

Disaster recovery. Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community.

Disaster rehabilitation. The set of actions taken after a disaster to enable basic services to resume functioning, to repair physical damage and community facilities, to revive economic activities and to support the psychological and social well-being of the survivors.

Disaster relief/response. Coordinated activities aimed at meeting the needs of people who are affected by a disaster.

Disaster risk reduction. Measures at all levels to curb disaster losses, through reducing exposure to different hazards and reducing the vulnerability of populations. Effective disaster risk reduction practices use a systematic approach to reduce human, social, economic, and environmental vulnerability to natural hazards.

Early warning. Providing timely and effective information about an imminent hazard that allows people to take action to avoid a disaster or prepare for effective response. Early-warning systems depend on a chain of things: understanding and mapping the hazard; monitoring and forecasting; processing and disseminating understandable warnings to political authorities and the population; and undertaking the right, timely actions in response to the warnings.

El Niño-Southern Oscillation (ENSO). An anomaly in sea surface temperature and atmospheric pressure in the tropical Pacific Ocean that occurs roughly every four to seven years and can lead to changes in seasonal rainfall in certain regions of the planet (large parts of Africa, Latin America, South East Asia, and the Pacific). An ENSO cycle includes two phases: El Niño and la Niña.

Extreme weather event. Weather that is extreme and rare in a particular place, such as extremely intense rainfall, extreme heat, a very strong windstorm. By definition, the characteristics of what is called “extreme weather” vary from place to place. Often it is defined as something that on average has happened less than once every 30, 50, or a 100 years. However, these events may occur at much more frequent intervals in the future due to the influence of climate change.

Global warming. The rise in average temperature on Earth due to the increasing amounts of greenhouse gases in the atmosphere. The media often use this term to refer to “climate change.”

Greenhouse gas. A gas, such as carbon dioxide and methane, that absorbs and re-emits infrared radiation. When pollution adds these gases to the Earth’s atmosphere, they trap more solar energy in our planet (like in a greenhouse) warming the Earth’s surface and contributing to climate change.

Hazard. A potentially damaging physical event that may cause loss of life or injury, property damage, social and economic disruption, or environmental degradation.

Heat island effect. A “dome” of elevated temperatures over an urban area or a part of an urban area caused by structural and pavement heat fluxes (heat radiation), and pollutant emissions.

Hot spot. A locale or area of high vulnerability to devastation due to impacts of climate change and natural disasters.

Hurricane. See *tropical cyclone*.

Hydro-meteorological. Natural processes or phenomena of atmospheric, hydrological, or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption, or environmental degradation. Hydro-meteorological hazards include: floods, debris, and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards, and other severe storms; drought, desertification, wildfires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydro-meteorological hazards can be single, sequential, or combined in their origin and effects.

Mitigation (Climate Change Management). Measures to reduce greenhouse gas concentrations in the atmosphere, and thus ultimately the magnitude of climate change. Measures include energy conservation, using renewable energy such as wind or solar energy instead of coal, oil, or gas; and planting trees that absorb carbon dioxide from the atmosphere.

Mitigation (Disaster Risk Management). Measures aimed at moderating or reducing the severity of disaster impact. The mitigation measures can be categorized as structural or nonstructural. Structural mitigation measures are intended to directly reduce the damage, save lives and protect property. They include such things as building retention walls, water reservoirs, and reforestation to avoid landslides. Nonstructural mitigation measures are intended to improve the ability to cope with the disaster. These measures include mock drills and improvement in preparedness. From the perspective of the climate change community, mitigation (disaster risk management) measures would be labeled as adaptation because they help reduce the negative impacts of climate change.

Monsoon. A seasonal prevailing wind in tropical and subtropical regions. It lasts for several weeks and leads to substantial changes in rainfall.

Natural hazards. Natural events that may harm people or their assets. Natural hazards can be classified by origin: geological (such as earthquakes and volcanic eruptions), hydro-meteorological (such as floods, heatwaves, storms), or biological (such as pests and locust swarms). Some natural hazards can be more likely to occur with human-induced climate change.

Plate tectonics. Mechanism of movement of Earth's plates. Plate tectonics is used to explain the global distribution of geological phenomena such as seismicity, volcanism, continental drift, and mountain building.

Precipitation. Rain, snow, or hail.

Reconstruction. See *disaster recovery*.

Recovery. See *disaster recovery*.

Ring of fire. A belt of seismic and volcanic activity roughly surrounding the Pacific Ocean. It includes the Andes Mountains of South America, the coastal regions of western Central America and North America, the Aleutian and Kuril Islands, the Kamchatka Peninsula, Japan, the island of Taiwan, eastern Indonesia, the Philippines, New Zealand, and the island arcs of the western Pacific.

Risk. The probability of harmful consequences due to interaction between hazards and vulnerable conditions.

Saltwater intrusion. Increase of salinity in underground freshwater located close to the coast. It can be caused by excessive withdrawal of water from the freshwater source (aquifer) or by sea-level rise.

Sea-level rise. An increase in the average level of the sea or ocean. The global sea level is rising as a result of increasing global temperature because: (1) melting of ice in mountains and glaciers leads to more water in the ocean, and (2) warmer water in the oceans expands, occupying more volume. Local sea levels are determined by a combination of the global sea-level rise and the local rise or subsidence of the land (for instance, due to geological processes).

Seasonal forecasting. Forecasting of probable weather conditions in a certain region during a certain period (for instance a month or a season) based on observed and projected oceanic and atmospheric conditions. These projections, sometimes months in advance, can help prepare for various emergencies, from hurricanes to malaria.

Seismic activity. Disturbances in the Earth's interiors resulting in release of energy. The release of energy produces earthquakes. Most seismic activities are associated with plate tectonics. Some seismic activities are also due to human actions such as construction of large reservoirs.

Sustainable development. Development that meets the cultural, social, political, and economic needs of the present generation without compromising the ability of future generations to meet their needs.

Tropical cyclone. A violent, rotating storm with heavy wind and rain. The most severe versions are called hurricanes (in the North Atlantic, the Northeast Pacific east of the dateline, or the South Pacific east of 160E) or typhoons (in the Northwest Pacific west of the dateline). Tropical cyclones only form and intensify above warm water and are probably becoming more intense due to the warming of the ocean surface caused by global warming.

Typhoon. See *tropical cyclone*.

Urban heat island effect. See *heat island effect*.

Vulnerability. The degree to which someone or something can be affected by a particular hazard (from sudden events such as a storm to long-term climate change). Vulnerability depends on physical, social, economic, and environmental factors and processes. It is related, for instance, to the places where people live, the strength of their houses, the extent to which their crops can survive adverse weather, or whether they have organized evacuation routes and shelters. Physical vulnerability relates to the built environment and may be described as “exposure”; social vulnerability is caused by such things as levels of family and social networks literacy and education, health infrastructure, the state of peace and security; economic vulnerability is suffered by people of less privileged class or caste, ethnic minorities, the very young and old, etc. They suffer proportionally larger losses in disasters and have limited capacity to recover. Similarly, an economy lacking a diverse productive base is less likely to recover from disaster impact, which may also lead to forced migration; environmental vulnerability refers to the extent of natural-resource degradation, such as deforestation, depletion of fish stocks, soil degradation, and water scarcity, all of which threaten food security and health.



Notes

1. A recent study Commissioned by the Natural Resource Defense Council (NRDC) shows that under business-as-usual conditions, with no new climate policies, the four cost categories—increased hurricane damages, residential real estate losses due to sea-level rise, increased energy costs, and water supply costs—will add up to \$1.9 trillion (in today’s dollars), or 1.8 percent of U.S. output per year by 2100.
2. CREDEM-DAT database.
3. World Bank, *East Asia Environmental Monitor: Adapting to Climate Change*, (Washington, D.C.: World Bank, 2007).
4. Cities Alliance, *Guide to City Development Strategies: Improving Urban Performance*. (Washington, D.C.: Cities Alliance, 2006, p. 24).
5. Cities Alliance, *Guide to City Development Strategies: Improving Urban Performance*. (Washington, D.C.: Cities Alliance, 2006, p. 11).
6. World Bank, *East Asia Environmental Monitor: Adapting to Climate Change*, (Washington, D.C.: World Bank, 2007).
7. World Bank, *East Asia Environmental Monitor: Adapting to Climate Change*, (Washington, D.C.: World Bank, 2007, p. 2).
8. University of California research claims China overtook the United States as the worst producer of carbon emissions in 2006–2007; published research forthcoming in *Journal of Environment Economics and Management*.
9. UN-HABITAT, *State of the World’s Cities 2006/7*. Nairobi, Kenya, 2006, p.136.
10. UN-HABITAT, *State of the World’s Cities 2006/7*. Nairobi, Kenya, 2006, p.12.
11. Demographia *World Urban Areas*, Belleville, Illinois, 2007.
12. Van Aalst, M. K., “The Impacts of Climate Change on the Risk of Natural Disasters,” *Disasters* 30(1): 5–18, 2006.
13. Schipper, L., and M. Pelling, “Disaster Risk, Climate Change, and International Development: Scope and Challenges to Integration,” *Disasters* 30 (1): 19–38, 2006; and Pelling, M., International Data On Disaster Risks, *World Disaster Report* (IFRC, Geneva, 2006).
14. UN-HABITAT, *State of the World’s Cities 2006/7*. Nairobi, Kenya, 2006, p.136.
15. Because understanding of some important effects driving sea-level rise is too limited, the 2007 IPCC report does not assess the likelihood, nor provide a best estimate or an upper bound for sea-level rise. See IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the IPCC (IPCC: Cambridge University Press, 2007).

16. A combined effect of sea-level rise, storm surge, and flood from upstream watersheds makes impact of climate change and variability on coastal regions even worse. According to IPCC (2007), it is predicted that millions of people living in low-lying coastal communities in India could become displaced as sea levels rise by up to 0.5 meters over the next 65 years. Moreover, local and regional economies will be hit hard from chronic food and water insecurity and epidemic disease, as well as extreme weather events. Similarly, a recent World Bank report indicates that India will have 0.3 percent of its area and 0.5 percent of its population affected by a one-meter sea-level rise. See Dasgupta, S., B. Laplante, C. Meisner, D. Wheeler, J. Yan, *The Impact of Sea-Level Rise on Developing Countries: A Comparative Analysis*. Policy Research Working Paper 4136 (Washington, D.C.: World Bank, 2007).
17. Nicholls, R.J, S. Hanson, C. Herweijer, N. Patmore, S. Hallegatte, J. Corfee-Morlot, J. Chateau, R. Muir-Wood, *Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes – Exposure Estimates* (OECD, Paris. 2007).
18. For example, Bangkok accounts for more than 36 percent of national GDP.
19. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
20. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
21. UN/ ISDR (United Nations International Strategy for Disaster Reduction). *Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action* (UNISDR, Geneva, Switzerland, 2008).
22. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
23. Baker, J. L., *Urban Poverty: A Global View*, Urban Paper Series (UP-5) (Washington, D.C.: World Bank, 2008).
24. World Bank, *East Asia Environmental Monitor: Adapting to Climate Change*, (Washington, D.C.: World Bank, 2007).
25. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
26. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
27. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
28. This applies to any of the IPCC scenarios.
29. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
30. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
31. IPCC, *Climate Change 2007: Synthesis Report – Summary for Policymakers*. Assessment of Working Groups I, II, and III to the Third Assessment Report of the International Panel on Climate Change (IPCC: Cambridge University Press, 2007).
32. IUCN, IISD, SEI, InterCooperation. 2003 quotes Girot 2002 and Folke et al. 2002
33. IUCN, IISD, SEI, InterCooperation. 2003.



34. IUCN, IISD, SEI, InterCooperation. The Resilience Alliance developed two workbooks for assessing resilience in social-ecological systems. The workbook project is an on-going effort with scheduled workshops, a developing database, proposals for creation of thematically based workbooks (e.g., a resilience assessment for coral reef systems), and development of companion volumes with supplementary background information. Key concepts provide a framework for assessing the resilience of natural resource systems and for considering management options to set the system on a sustainable trajectory. The practitioners' workbook has been developed specifically to provide guidance to people engaged in natural resource management through a set of activities designed to explore system parameters and management options for their own system of interest from a resilience perspective. The workbook for scientists emerged from case study comparisons and is intended as a guide for those already familiar with the basic concepts of resilience and systems dynamics. See *Assessing and Managing Resilience in Social-Ecological Systems: The Resilience Alliance Practitioner's Workbook*, and *Assessing Resilience in Social-Ecological Systems: A Workbook for Scientists* (www.resalliance.org).
35. Mostly, the return period substantially exceeds 10 years.
36. According to the U.S. National Oceanic and Atmospheric Administration (NOAA), it is probable that heat waves will become more likely and progressively more intense over the course of decades under current climate change scenarios (www.ncdc.noaa.gov).
37. With a total number of 120 million, China's floating population is not only the biggest migrant population but also one of the most mobile populations in the world.
38. If the head of government is selected by appointment, stakeholder engagement and consultations are less likely to occur. Climate change and disaster risk management strategies do need to have consultation and strong engagement to succeed.
39. Based on IPCC (2001), many scientists distinguish two basic kinds of Hot Spots in a map: (a) The *fingerprints* of global warming such as heat waves, rising seas, and the melting of mountain glaciers, which are indicators of the global, long-term warming trend observed in the historical record. Fingerprints are what researchers seek to detect and then to confirm that climate change is indeed underway. (b) By contrast, *harbingers*, such as exceptional droughts, fires, downpours, the spread of disease-bearing insects or other carriers, and widespread bleaching of coral reefs, may be directly or partly due to the warmer climate, but it is impossible to say for sure. Harbingers are events that are consistent, given our current scientific theories and models, with the kind of impacts projected to occur as global climate change proceeds. For more details, see <http://www.climatehotmap.org/criteria.html>
40. There are other similar initiatives. For examples, in the United States, the Climate Change Networks stated that "due in large part to the failure of the federal government to adopt policies to address climate change, states have enacted their own binding emission reduction requirements, and as a result of the state initiatives, it is the states, not the federal government that are at the cutting edge of mandatory climate policy in the United States" (<http://usclimatenetwork.org/stateaction/turning-the-tide/1-0-mandatory-climate-change-policy>). Moreover, the Regional Greenhouse Gas Initiative (RGGI) is the first multi-state GHG emissions cap-and-trade program in the United States. As members of RGGI, states voluntarily agree to a regional cap-and-trade program covering power plant carbon dioxide emissions. RGGI aims to cap these emissions at approximately current levels between 2009 and 2015, and then reduce this level 10 percent by 2019 (<http://www.rggi.org>).
41. Gurenko, E., and R. Lester, *Rapid Onset of Natural Disasters: The Role of Financing in Effective Risk Management*, Insurance and Contractual Savings Practice (World Bank Policy Research Paper 3278, Washington, D.C, 2004).
42. Gurenko, E., and R. Lester, *Rapid Onset of Natural Disasters: The Role of Financing in Effective Risk Management*, Insurance and Contractual Savings Practice (World Bank Policy Research Paper 3278, Washington, D.C, 2004).
43. Association of British Insurers, *A Future for Flood Plans*, July 2006. <http://www.abi.org.uk/BookShop/ResearchReports/A%20Future%20for%20the%20Floodplains.pdf>



44. Association of British Insurers, *Summer Floods 2007: Learning the Lesson*, November 2007. <http://www.abi.org.uk/BookShop/ResearchReports/Flooding%20in%20the%20UK%20Full.pdf>.
45. UN/ ISDR (United Nations International Strategy for Disaster Reduction). *Indicators of Progress: Guidance on Measuring the Reduction of Disaster Risks and the Implementation of the Hyogo Framework for Action* (UN/ ISDR, Geneva, Switzerland, 2008).
46. As of May 2006, 113 car models or 25 percent of the total car models in Singapore have been registered under the scheme.
47. For examples, see the maps of the Chicago's Center for Neighborhood Technology at www.cnt.org.
48. Municipal World, February 2007.
49. Presentation by Saroj Kumar Jha, entitled "Mainstreaming disaster reduction in poverty reduction: attaining and sustaining MDGs," Washington, D.C., World Bank, September 2005.
50. The level of investment required was estimated at \$224 billion or about \$15 billion per year. The annual damage in the Asian and Pacific region was equivalent to about two-thirds of global annual lending by the World Bank. Disaster-related lending by the World Bank over the past 25 years has totaled only \$20 billion for Asia and the Pacific.
51. Viner, D., and L. Bouwer, *Linking Climate Change Adaptation and Disaster Risk Management for Sustainable Poverty Reduction*, Vietnam Country Study (Vulnerability and Adaptation Resource Group, 2006).
52. The complete strategy is accessible at www.rockvillemd.gov/environment/sustainability.



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Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters provides city administrators with exactly what they need to know about the complex and compelling challenges of climate change. The book helps local governments create training, capacity building, and capital investment programs for building sustainable, resilient communities. A step-by-step self-assessment challenges policymakers to think about the resources needed to combat natural disasters through an innovative “hot spot” risk and vulnerability identification tool.

This primer is unique from other resources in its treatment of climate change using a dual-track approach that integrates both mitigation (lowering contributions to greenhouse gases) and adaptation (preparing for impacts of climate change) with disaster risk management. The book is relevant both to cities that are just beginning to think about climate change as well as those that already have well established policies, institutions, and strategies in place. By providing a range of city-level examples of sound practices around the world, the book demonstrates that there are many practical actions that cities can take to build resilience to climate change and natural disasters.

“Climate change is real. The contents of the Primer are timely and are of importance to many local governments like Albay.”

—**Joey Sarte Salceda**
Governor, Albay Province, the Philippines

“The Primer—which focuses on reducing vulnerability to climate change impacts and related disasters—is a useful and valuable reference for . . . city managers and local government leaders.”

—**Emeritus Mayor Peter Woods OAM**
Secretary General, United Cities and Local Governments Asia-Pacific (UCLG ASPAC)

“We commend the World Bank, the Global Facility for Disaster Reduction and Recovery, and the United Nations International Strategy for Disaster Reduction’s efforts on the Primer of guidelines to strengthen the capacity of local governments and partners in building resilient communities. CITYNET is very proud to be part of this initiative and we hope to promote optimal usage of the Primer through activities on mainstreaming disaster risk reduction and climate change in overall urban planning and management.”

—**Dato’ Lakhbir Singh Chahl**
Secretary General, CITYNET (Regional Network of Local Authorities for the Management of Human Settlements)

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