

# City Indicators on Climate Change: Implications for Policy Leverage and Governance

Author:  
Professor Patricia L. McCarney, PhD  
Global City Indicators Facility  
University of Toronto

World Bank's 5<sup>th</sup> Urban Research  
Symposium  
Marseilles, France  
June 28-30, 2009

## Table of Contents

- I. INTRODUCTION
- II. MAPPING CLIMATE CHANGE RISKS IN CITIES: CORE RISKS AND URBAN VULNERABILITIES
  - i. Urban Vulnerabilities Associated with Climate Change – Categorizing Risks
  - ii. Mapping Cities and Climate Change
  - iii. Using Indicators to Assess and Address Deeper and Enduring Risks and Long-Term Vulnerabilities in Cities
- III. CITIES AT RISK: EMERGING APPROACHES TO SAFER CITIES
  - i. From Indicators to Governance – Evidence Based Policy Formulation
  - ii. The Role of City Indicators on Climate Change for Effective Planning and Management
  - iii. Addressing Risks and Vulnerability in Cities through a more Empowered, Cohesive and Inclusive Governance
- IV. CONCLUSION
  - i. Research Challenges for Improved Measurements, Indicators and City Data on Climate Change
  - ii. Governance Challenges for Building Climate Resilient Cities in the Future

## Introduction: Risks Associated with Climate Change Are Increasingly Finding Expression in Cities

- GHG emissions, sea level change, land and air temperature adjustments, air quality deterioration, shifting rain, wind and snow patterns and other unstable climate shifts, while global in nature, find expression in the world's cities
- Leads to new complexities and challenges in governing cities and new research challenges to measure and monitor these risks in order to inform policy, planning and management

## The Challenge

- City leaders are not at the table when international protocols and agreements on climate change are discussed by member states and when states decide on whether to sign and support these international agreements
- The vulnerability of cities to climate change risks is largely underestimated. There is no established set of city indicators on climate change that is globally standardized and comparable.
- With increasing urban vulnerability however, estimated simply by the fact of the increasing dominance of city dwellers worldwide, city governments need to be considered as new sites of governance in global negotiations on climate change and in decision-making related to risk assessments.
- Comparative city data engenders a critical voice for cities in global dialogues and national policy development

## Research Objectives

1. To map core risks for cities associated with CC through literature review and city case studies
2. To examine the use of city indicators to assess and address risks and vulnerabilities in cities
3. To determine how knowledge derived from city indicators on CC can help to direct a more informed set of planning norms and practices, more effective infrastructure investment and urban management, and a more empowered and inclusive urban governance

## Introduction – The Context

- Cities in the 21<sup>st</sup> century face unprecedented challenges:
  - The world's urban population is expected to reach 4.2 billion by 2020
  - The urban slum population is expected to reach 1.4 billion by 2020
  - Social cohesion, safety, security and stability are being tested by social exclusion, inequities and shortfalls in basic services
- A multi-faceted city governance approach to climate change must include effective and long-term solutions

## Cities and Climate Change

- Cities are key actors in the climate change agenda
  - Power to pass legislation related to greenhouse gas emissions
  - Capacity to encourage participation and civic engagement
  - Build more inclusive institutions for achieving environmental objectives
  - Plan and design transportation systems
  - Power to ensure strong and robust local economic development patterns
  - Power to address land tenure (pro-poor policies)
  - Power over building codes and zoning by-laws
  - Develop creative financing tools for mobilizing investments that help to overcome threats

## Introduction

- There is no established or standardized set of city indicators that measures the effects of climate change on cities
- Nor is there a comprehensive set of indicators with a common, accepted methodology designed to measure the impact that cities have on climate change
- The creation of measures and indicators will allow for informed decision-making and improved policy on climate resiliency in cities, more effective urban management of risks, and a more empowered governance at the city level

## Urban Vulnerabilities Associated with Climate Change

### ■ Four categories to assess urban vulnerabilities

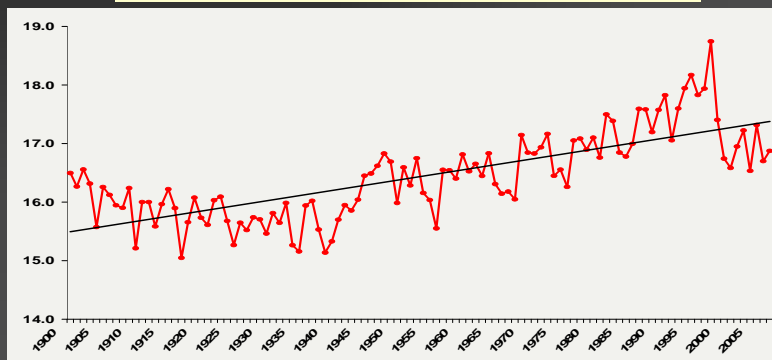
1. Alterations in temperature
2. Alterations in precipitation
3. Alterations in storm intensity
4. Sea level change

➤ Identification of these vulnerabilities helps build a framework for mapping and measuring climate risks in cities

## Urban Vulnerabilities and Climate Change: Alterations in Temperature

- Mexico City – steady increase over the past century and particularly since about 1960

Temperature (°C) Average in Mexico City 1900-2007

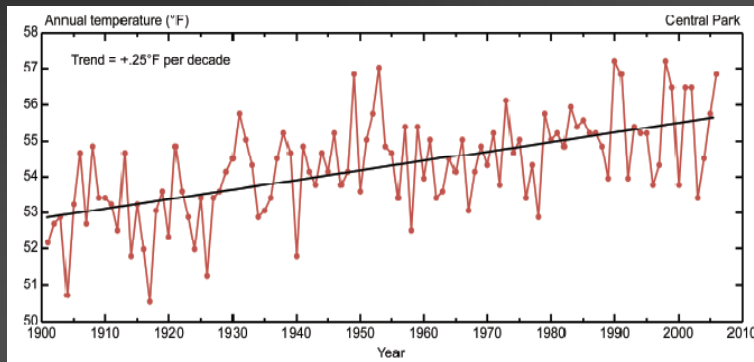


Source: Secretaria del Medio Ambiente del Distrito Federal, 2008. *Mexico City Climate Action Program 2008-2012*

## Urban Vulnerabilities and Climate Change: Alterations in Temperature

- New York City – steady increase since 1900 and increase in number of “hot days” (over 90 F) since 1980

**Annual Temperature in Central Park, Manhattan 1901-2006**



Source: New York City Panel on Climate Change, 2009. *Climate Risk Information*

## Urban Vulnerabilities and Climate Change: Alterations in Temperature

Key consequences for cities associated with *alterations in temperature* include:

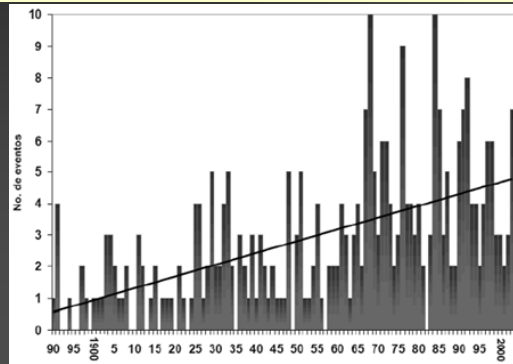
- warmer and more frequent hot days and nights in cities
- more extreme events such as heat waves
- increased demand for cooling
- declining air quality in cities
- energy shortages
- heat island effects
- increased water demand and water quality problems
- human health effects and increased risk of heat-related mortality

Create a cluster of impacts that confront city governments and point to data needs and indicators development

## Urban Vulnerabilities and Climate Change: Alterations in Precipitation

- Mexico City – more than a century of data collected, marked increase since 1965 (most cities globally do not collect data on occurrences of heavy precipitation despite serious results)

### Number of Extreme Precipitation Events (>30mm/day) in Mexico City 1890-2003

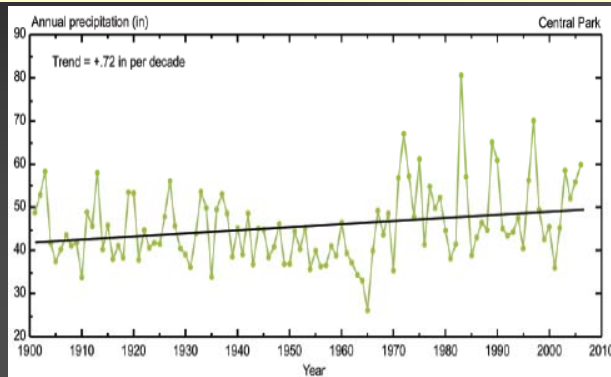


Source: Secretaría del Medio Ambiente del Distrito Federal, 2008. *Mexico City Climate Action Program 2008-2012*.

## Urban Vulnerabilities and Climate Change: Alterations in Precipitation

- New York City – gradual increase in annual precipitation over the past 100 years

### Annual Precipitation in Central Park, Manhattan 1901-2006



Source: New York City Panel on Climate Change, 2009. *Climate Risk Information*.

## Urban Vulnerabilities and Climate Change: Alterations in Precipitation

Key consequences associated with alterations in precipitation:

### 1. Increasing frequency and intensity of precipitation

- Cause deterioration of water and sanitation infrastructure
- Create adverse effects on the quality of surface and groundwater
- Contaminate water supply
- Create waterborne diseases; increase risk of deaths, infectious respiratory and skin diseases
- Disrupt settlements, commerce and transport due to flooding, cause large displacements of people together with loss of property

### 2. Alterations in precipitation leading to drought

- Lead to adverse effects in cities, escalating costs of food and food crises
- Cause increased migration into cities from drought affected regions

Consequences for governing, planning and managing cities

Pointing to measurement needs

## Urban Vulnerabilities and Climate Change: Alterations in Storm Frequency/Intensity

- Global and national data on storms being generated, however city level measures assessing these vulnerabilities not yet well formulated
- Data on three major storms since the year 2000 that directly affected cities demonstrated consequences, namely settlement disruption, loss of property and mortality
  1. Mozambique 2000, storm consequences in Maputo and other cities - loss of property, 700 deaths and settlement disruption to 4.5 million
  2. Germany and other neighboring countries flooding along the Elbe and Danube Rivers 2002 - damage to Dresden and other cities, mortality reached 90 and 30,000 people were evacuated from Dresden
  3. New Orleans 2005 largest storm disaster in US history - deaths reaching 1,863 and economic losses measured at \$US81.2 billion

## Urban Vulnerabilities and Climate Change: Alterations in Storm Frequency/Intensity

Consequences for cities include

- power outages and disruption to the public water supply
- disruptions to settlements associated with flood and high winds
- migration of population under stress
- loss of property; withdrawal of risk coverage or cost escalation of insurance by private insurers
- increased risks of deaths, injuries, and water and food-borne diseases and post-traumatic stress disorders

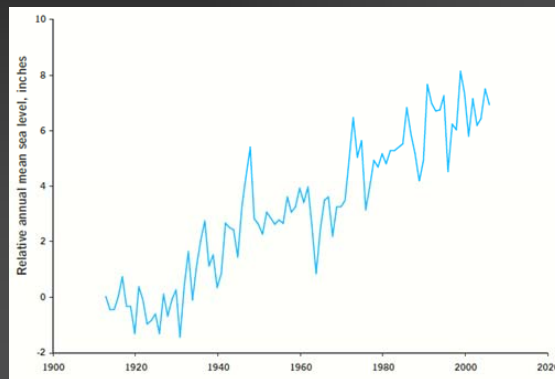
Consequences for governing, planning and managing cities

Pointing to measurement needs

## Urban Vulnerabilities and Climate Change: Sea Level Change

- Miami – measured from Key West

### Mean Annual Sea Level Rise in Key West, Florida Over Time

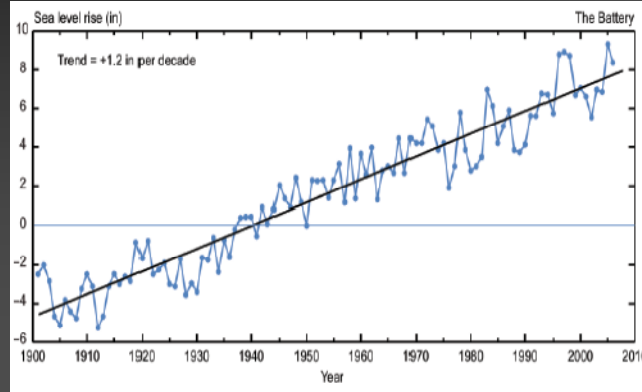


Source: The City of Miami, 2008. *MIPlan: City of Miami Climate Action Plan*.

## Urban Vulnerabilities and Climate Change: Sea Level Change

### ■ New York City – measured from The Battery

**Graph 8: Annual Average Sea Level – New York City**



Source: New York City Panel on Climate Change, 2009. *Climate Risk Information*.

## Urban Vulnerabilities and Climate Change: Sea Level Change

Consequences associated with sea level change include:

- permanent erosion and submersion of urban land and settlements, loss of property and livelihood
- costs of coastal protection
- costs of land-use relocation
- decreased freshwater availability due to saltwater intrusion and salinity in estuaries and coastal aquifers
- increased risks of deaths and injuries by drowning in floods
- rising water tables and impeded drainage
- destruction of urban infrastructure
- long-term effects on economic growth

Informs measurement needs and core indicators for assessing urban vulnerabilities associated with sea level change - what city level measures already exist and gaps in current information.

## Deeper and Enduring Risks and Long-term Vulnerabilities in Cities

- 80% of urban residents in the lowest income countries living in slum conditions, expected to double by 2030
- UN MDG 7: “Ensure Environmental Sustainability”
  - Three targets:
    - reverse the loss of environmental resources
    - improve access to safe drinking water
    - improve the lives of slum dwellers
  - UN-HABITAT’ agenda to monitor progress towards the goal of improving the lives of slum dwellers is a core component of reducing vulnerability of citizens to CC
    - Insecure residential status
    - Inadequate access to safe water
    - Inadequate access to sanitation
    - Poor structural quality of housing
    - Overcrowding

## Urban Vulnerabilities – Bringing Poverty into the Discussion

- CC Agenda is also helping to elevate the discourse on development - reducing poverty is a key component in reducing vulnerability of urban citizens
- The relation between climate change risks and urban health is heightened under conditions of urban poverty
  - Inadequacy of basic infrastructure, poor sanitation and drainage, impure drinking water stressed, leading to the transmission of infectious diseases
  - In high density areas, floodwaters in slums can mix with raw sewage, and breed water-borne diseases (e.g. diarrhea, typhoid and scabies)
  - Many developing countries lack the health facilities to deal with large numbers of patients, resulting in higher death tolls
- Poorer urban households are at higher risk due to:
  - Weaker structures
  - Less safe city locations and building sites
  - Weaker resilience of infrastructure to withstand damage

# City Adaptation Strategies

- Building cities' resilience to the adverse impacts of climate change
- UN-Habitat has identified five sectors for cities to consider CC adaptation options and strategies:
  1. Water
  2. Infrastructure and Settlements
  3. Human Health
  4. Urban Transport
  5. Energy

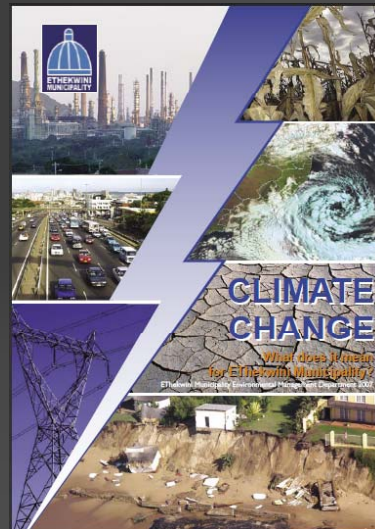
(Table 3 in Paper)

City Cases on Adaption Plans →

## Strategic Planning for Climate Adaptation eThekweni Municipality Case Study

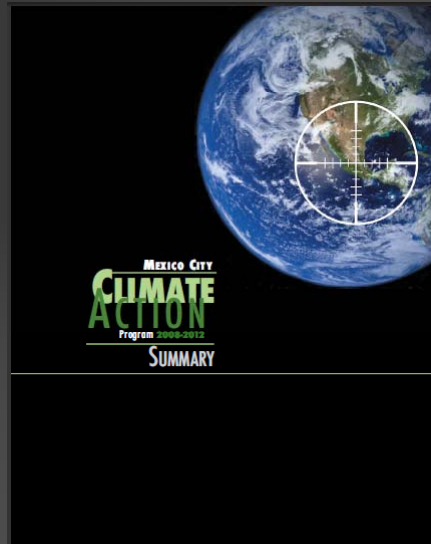
Durban 's Adaptation strategies:

- **Water Loss Management Project**
- **Environmental Services Management Plan** to secure the municipality's open spaces
- **Urban Agriculture Program** to enhance local food provision
- Working to control and eradicate alien invasive plants
- Mapping predicted changes in areas vulnerable to malaria



## Strategic Planning for Climate Adaptation Mexico City Case Study

- Mexico City's vulnerability to CC has been identified as a national security issue
- Program of CC Adaptation Measures has been integrated into the Climate Action Program
- Twelve CC Adaptation Actions



## Strategic Planning for Climate Adaptation New York City Case Study

- PlaNYC 2030's adaptation priorities:
  - securing New York's existing infrastructure
  - identifying and protecting flood plain zones and specific at-risk communities
  - establishing a citywide strategic planning process with emphasis on tracking emerging climate change data and its potential impacts on the city



## Strategic Planning for Climate Adaptation London Case Study

- City of London has detailed three climate impacts in the London Climate Change Adaptation Strategy: heat waves, floods and droughts, each considered as high risk of consequence and vulnerability, as well as increasing probability
- Link to document - <http://www.london.gov.uk/mayor/publications/2008/docs/climate-change-adapt-strat.pdf>



## City Mitigation Strategies

- CCI informs cities are responsible for 75% of the greenhouses gases released into our atmosphere – again positions cities as key actors on the climate change agenda
- However, measurements of carbon emissions in cities are uneven in development and application to guide city mitigation strategies – the need for standardized and globally comparative data can strengthen policy leverage and inform city management

## City Mitigation Strategies

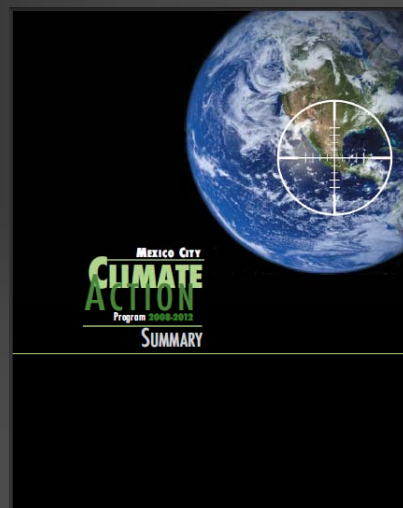
- Various protocols exist for GHG emissions calculations.

Examples:

- ICLEI's Local Government GHG Emissions Analysis Protocol
  - Two-pronged analysis: local government emissions are a component of community emissions, together forming a complete GHG emissions inventory
- Protocol developed by Chris Kennedy et al., 2009
  - Uses seven components: electricity, heating and industrial fuels, direct industrial emissions, ground transportation, air, marine and waste

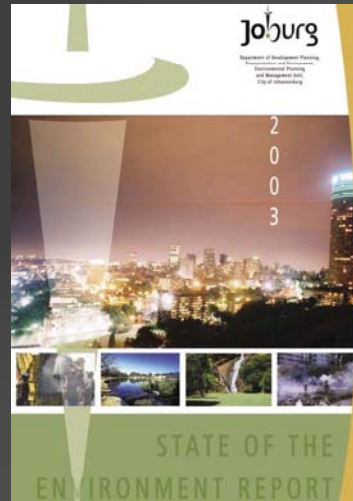
## City Mitigation Strategies – Case of Mexico City

- Implementation of energy efficiency programs
- Establishment of environmental certification systems for buildings
- Funding for new housing with integrated sustainability criteria
- Construction of sewerage and water treatment services in areas of low methane gas
- Obligatory school transportation system



## City Mitigation Strategies – Case of Johannesburg, South Africa

- Retrofitting of council buildings
- Energy savings in water pump installations
- Methane gas recovery
- Constructing LEED-certified buildings



## City Mitigation Strategies – Case of Portland Oregon

- Program to support the design and development of green buildings through technical assistance, education and financial incentives
- Reduce energy by increase in renewables
- Conversion of all traffic signals to highly efficient LED bulbs



### III. FROM INDICATORS TO GOVERNANCE

#### From Indicators to Governance – Evidence Based Policy Formulation

- Why indicators for more effective governance
  - Indicators provide a useful tool in the prospective sense for policy making by aiding in comparison and prediction, steering investments and refining policy choices
  - Retrospective sense for assessing policy implementation by aiding in evaluation, tracking problems, measuring implementation success rates
  - Indicators promote transparent decision making processes, foster citizen participation in policy development and influence behavioural change

## From Indicators to Governance – Evidence Based Policy Formulation

- While country-level data and analysis on climate change have improved in recent years, serious gaps exist at the city level
- Quantitative city data on climate change is being developed by cities in some discreet form and often adapted from broadly accepted national level methods
- Gaps and the lack of time series data on cities and climate change hamper efforts to diagnose emerging risks and problems, to assess policy options in terms of both mitigation and adaption strategies, and to gauge the effectiveness of their city-level programs.

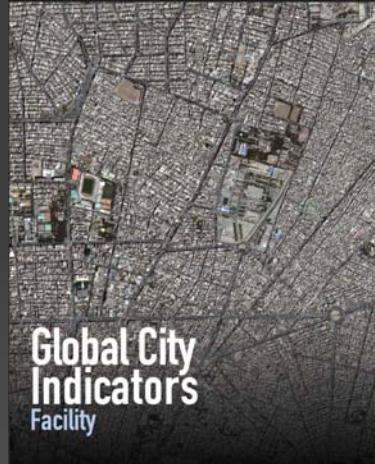
## From Indicators to Governance – Evidence Based Policy Formulation

- Globally comparative indicator-based knowledge on cities and climate change increasingly more important as national measures evolve and country-level policy positions emerge
- City-level indicators that have a globally standardized methodology are important, not for purposes of numerical ranking of cities, but for informing policy decision-making through comparative city data that provides policy leverage for city leaders locally, nationally and globally

## From Indicators to Governance – Evidence Based Policy Formulation

- World Bank's Global City Indicators Program provides a system for cities to use globally standardized indicators as a tool for informing policy making through the use of international comparisons

Web Page:  
[www.cityindicators.org](http://www.cityindicators.org) hosts a comprehensive indicators database



## From Indicators to Governance Case Studies

- Bogota
  - Secretariat of Finance utilizes GCIP Indicators and comparative reports to:
    - Monitor investments and evaluate their performance
    - Use other member cities' performance as benchmarks in measuring Bogota's performance
    - Inform effective evidence-based decision making during budget negotiations

## From Indicators to Governance Case Studies

### ■ Sao Paulo

- Local government utilizes GCIP to:
  - Increase government transparency and accountability
  - Regain legitimacy and public confidence in government statistics
  - Prepare “Agenda 2012” – the mayor’s public commitment to a set of quantitative priorities, goals, and targets

## From Indicators to Governance Sao Paulo Case Study

- Agenda 2012 presents 223 targets organized in six themes:
  - a social rights city
  - a sustainable city
  - a creative city
  - an opportunity city
  - an efficient city
  - an equal city



Agenda 2012  
Programa de Metas da Cidade de São Paulo

The municipality must report its results, periodically – and at least every six months. In this sense, the global city indicators that the City of Sao Paulo collects as part of the Global City Indicators Program allows the City to measure performance, impacts and policies effectiveness

## From Indicators to Governance – Evidence Based Policy Formulation

- The World Bank defines indicators as performance measures that aggregate information into a usable form
- Policy-resonant indicators, those that “strike a chord with the intended audience” improve the accountability and efficiency of local policy processes by building stakeholders’, public, and community understanding of issues and their solutions. Indicator systems pool enormous amounts of previously inaccessible data, making possible long-term trend monitoring that is important for governments to prioritize actions (Hezri & Dovers, 2006, 9-10)

## From Indicators to Governance – Evidence Based Policy Formulation

- Indicators can influence how issues are constructed in the public realm - important lesson related to cities and climate change since information can help to direct behavior in building climate action
- Behavioral change can result from publicly accessible information by becoming embedded in the thought and practices, and institutions of users (Innes, 84, 1998).
- Hezri and Dovers argue for example that “as a source of policy change, learning is dependent on the presence of appropriate information with the capacity to change society’s behavior” (2006, 11)

## From Indicators to Governance – Evidence Based Policy Formulation

Improving citizens' access to information and maintaining a relationship of accountability between local governments and their citizens are critical to improving a city's climate resilience

Addressing climate change risk in cities depends on the availability and accessibility of information on climate risks and an engaged, informed urban citizenry involved in the formulation of climate action plan

## From Indicators to Governance – Evidence Based Policy Formulation

- Urban sustainability indicators aid in decision-making promote local information, empowerment and democracy; contribute to making the city's process of decision-making more visible and transparent; are important instruments for fostering citizen participation; and can improve the effectiveness of active citizen involvement in decision-making and policy development. (Voula Mega and Pedersen 1998)
- City indicators on climate change can therefore enhance understanding of the risks associated with climate change, influence opinion and behavior, shape policy, determine priorities, and thereby impact a city's relative contribution to global climate change.

## From Indicators to Governance

- Research Challenges
- Governance Challenges

## Three Research Challenges (1)

- *First* -- Localizing measurements on climate change
  - While national and global measurements have advanced, a credible and globally standardized measurement for how cities impact climate change is needed
  - To establish mitigation targets for cities – requires research by sector to establish performance measures in meeting targets
  - Research on risk and vulnerability of cities to CC to inform citizens and policy makers across specified categories at the city level

## Three Research Challenges (2)

- *Second* -- Establishing a globally comparative and standardized set of measures
  - When individual cities collect and monitor data on climate change, the information is often collected using methodologies different from other cities that is analyzed and reported on in different ways
  - Assessing and consolidating/integrating existing protocols

## Three Research Challenges (3)

- *Third* -- Defining urban jurisdictional boundaries
  - There is no consistent definition for an “urban area” or “municipality” or “metropolitan area”
  - Inconsistent definitions pose challenges for research, performance targets, indicators and measurements in the field of climate change
  - Multiple and overlapping jurisdictions across levels of government (vertical) and diffuse urban territories (horizontal)

## Governance Challenges

- Cities are being recognized as a pivotal policy platform for both global action on climate change and local responsibility for mitigating climate change and building climate resilient cities ....

## Governance Challenges

- Critical questions face policy makers and leaders in all levels of government due to:
  - Deficient intergovernmental relations – devolution of power
  - Inadequate popular local representation processes
  - Weak forms of civic engagement - how to foster an inclusive governance process
  - Weak sub-national institutions
  - Complex jurisdictional boundaries and fragmentation in local governance
  - Poor financing mechanisms to sub-national government forms – responsible fiscal federalism

## Governance Challenges

- Many city governments are weakened due to limited power and responsibility over services key to climate action, such as:
  - Planning
  - Housing
  - Roads and transit,
  - Water
  - Land-use
  - Drainage
  - Waste management
  - Building standards

## Governance Challenges

- Climate change actions require coherence and integration across jurisdictions
- Larger metropolitan areas are facing challenges in addressing climate change due to fragmentation:
  - As urban populations grow, traditional municipal boundaries and traditional governing structures become outdated
  - Fragmented governance brings challenges to the possibilities of efficient planning, management and urban financing for climate action planning

## Governance Challenges

### ■ Jurisdictional Coordination

- Multi-level jurisdictional coordination of services vertically across multiple levels of government
  - Multiple tiers of government and various levels of state agencies are involved in the climate change agenda and vertical coordination is often weak or non-existent
- Inter-jurisdictional coordination of services horizontally across the metropolitan area
  - Coordination is fundamental to basic sectoral areas such as land, transport, energy, emergency preparedness, related fiscal and funding solutions, and issues of poverty and social exclusion

## Governance Challenges

### ■ Efficient financing

- A core requirement for climate action by cities
- Highly fragmented governance arrangements in many metropolitan areas makes efficient financing for area wide climate mitigation and adaptation strategies a difficult and on-going challenge
- Without a clear, permanent and sufficient financial mechanism - difficult to implement planning for more climate resilient cities

## Conclusion

- Indicators on cities and climate change add new policy leverage for local governments
  - Building empowered decision-making in this volatile policy field
  - Leveraging funding/budget support for climate action
  - In developing evidence-based policy-making
  - In building strong city governments capable of performing as new sites of governance in global negotiations on climate change
  - In decision-making related to risk assessments