

**WORLD BANK GEF**

# MAINSTREAMING CLIMATE CHANGE MITIGATION IN CITIES



**GLOBAL ENVIRONMENT FACILITY PROGRAM  
THE WORLD BANK**



INVESTING IN OUR PLANET



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MITIGATION IN CITIES

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GLOBAL ENVIRONMENT FACILITY PROGRAM  
THE WORLD BANK

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## FOREWORD

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It is estimated that urban areas currently contribute to about 75 percent of greenhouse gas emissions through energy use, waste management and land use changes. As urbanization increases around the globe, with the urban population expected to more than double over the next 25 years from the current 3.2 billion urban dwellers, this problem is likely to become increasingly exacerbated.

However, this also raises the possibility of opportunities for urban solutions. Cities offer enormous opportunities for climate change mitigation that are starting to be noticed and captured. This study focuses on

the opportunities available for climate change mitigation in World Bank urban sector projects and represents the first systematic effort in this area.

The report has already been well received by colleagues within the Bank and is considered a significant contribution to the Bank's Cities and Climate Change work program. With a growing carbon market and increasing donor financing for climate change, we now have an enhanced ability to internalize climate change mitigation interventions in operations and can hopefully bring greater benefits to our client countries.



## ABBREVIATIONS AND ACRONYMS

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AFR	Africa Region
APL	Adaptable Program Loan
ARI	Air Conditioning and Refrigeration Institute
BRT	Bus Rapid Transit
CAS	Country Assistance Strategy
CC	Climate Change
CDM	Clean Development Mechanism
CFL	Compact Fluorescent Lamps
CHP	Combined Heat and Power
CNG	Compressed natural gas
DSM	Demand-Side Management
EAP	East Asia and Pacific Region
ECA	Europe and Central Asia
GEF	Global Environmental Facility
GHG	Green House Gases
GIS	Geographic Information System
IBRD	International Bank for Reconstruction and Development
ICLEI	International Council for Local Environmental Initiatives
ICR	Implementation Completion Report
IDA	International Development Association
IEA	International Energy Agency
ITS	Intelligent Transportation Systems
LCR	Latin America and Caribbean Region
LSG	Local Self-Government

MNA	Middle East and North Africa Region
M&V	Measurement and Verification
MUNEE	Municipal Network for Energy Efficiency
NGO	Nongovernmental organization
NMT	Non-Motorized Transport
PCN	Project Concept Note
PAD	Project Appraisal Documentation
PDO	Project Development Objectives
PREM	Poverty Reduction and Economic Management Network
PRSP	Poverty Reduction Strategy Paper
PSAC	Program Development Policy Credit
PSAL	Private Sector Adjustment Loan
PSD	Private Sector Development
SAR	South Asia Region
SDN	Sustainable Development Network
SIDA	Swedish International Development Corporation
SIL	Specific Investment Loans
SWAp	Sector-Wide Approaches
SWM	Solid Waste Management
SWOT	Strengths, weaknesses, opportunities, and threats
TDM	Transportation Demand Management
UFW	Unaccounted for Water
ULB	Urban Local Body
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WSS	Water Supply and Sanitation

## EXECUTIVE SUMMARY

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### Objectives

Today, half of the world's population lives in cities, accounting for three-quarters of global energy use and greenhouse gas emissions. In the coming years, as urbanization increases, mitigating climate change will become an increasingly important part of the urban assistance portfolio. Recognizing this trend, the World Bank's Global Environment Facility (GEF) Climate Change Program undertook a desk study to identify opportunities for scaling-up the contribution of global environmental financing to the World Bank's urban portfolio.<sup>1</sup>

Specific objectives of the study were to: determine the extent to which climate change mitigation opportunities have been integrated into urban assistance projects; identify climate change mitigation mainstreaming opportunities for future projects; identify entry points for mainstreaming climate change mitigation in urban projects; highlight examples of non-World Bank good

practice for climate change mitigation in urban infrastructure; and develop an understanding of operational considerations to help integrate climate change mitigation in urban projects.

The study comprised three parts:

- a review of the Bank's 1995–2005 urban portfolio to document opportunities for climate change mitigation;
- a review of good practice outside the Bank for climate change mitigation targeted at urban infrastructure; and
- consultations with urban sector practitioners regarding practical aspects of incorporating climate change mitigation components into urban infrastructure projects.

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<sup>1</sup> This report refers to cities, municipalities, and the urban portfolio interchangeably. Urban is defined as relating to the built-up areas of the world, including cities, municipalities, and peri-urban regions.

Table 1: Summary of Incremental Climate Change (CC) Mitigation Opportunities by Type of Urban Infrastructure

<b>Urban Transport</b>	<b>Urban Water Supply &amp; Sanitation</b>	<b>Urban Solid Waste Management</b>	<b>General Urban Infrastructure, including Buildings</b>
<p><b>Typical Components:</b></p> <ul style="list-style-type: none"> <li>• Highway Construction</li> <li>• Urban Bus Fleets</li> <li>• Improved Pedestrian Access</li> <li>• Signage, Crossings, traffic safety</li> <li>• Mass Transit Systems</li> <li>• Modal Integration</li> </ul>	<p><b>Typical Components:</b></p> <ul style="list-style-type: none"> <li>• Water supply, storage and treatment facilities</li> <li>• Secondary and tertiary distribution networks</li> <li>• Capacity building for WS&amp;S operators</li> <li>• Institutional reform</li> <li>• Loss reduction</li> <li>• Sewage collection, treatment and outfall facilities</li> <li>• Water supply and sewerage connections</li> <li>• Water pressure and quality monitoring systems</li> </ul>	<p><b>Typical Components:</b></p> <ul style="list-style-type: none"> <li>• Establishing &amp; managing sanitary landfills</li> <li>• Establishing and operating municipal waste collection schemes</li> <li>• Local recycling schemes</li> <li>• Capacity building of municipal solid waste operators</li> <li>• Encouraging proper waste disposal practices</li> <li>• Regulating uncontrolled &amp; informal disposal operation</li> </ul>	<p><b>Typical Components:</b></p> <ul style="list-style-type: none"> <li>• Steam or hot water production and distribution facilities</li> <li>• Capacity building of district heating providers and heat sector reform</li> <li>• Heat metering and demand management equipment</li> <li>• Retrofitting of public buildings for energy efficiency</li> <li>• Replacement of boilers and other equipment.</li> </ul>
<p><b>Incremental CC Mitigation Opportunities:</b></p> <ul style="list-style-type: none"> <li>• Improved Urban Planning</li> <li>• Bus Rapid Transit</li> <li>• Land Use Planning</li> <li>• Vehicle Emissions Inspections</li> <li>• Street Lighting</li> <li>• Vehicle fleet renewal with high-efficiency clean vehicles</li> <li>• Traffic Demand Management (e.g., rotating odd-even access)</li> <li>• Fiscal &amp; tax regimes, including congestion charges &amp; engine capacity taxes</li> <li>• Non-Motorized transport (dedicated bike &amp; pedestrian pathways)</li> </ul>	<p><b>Incremental CC Mitigation Opportunities:</b></p> <ul style="list-style-type: none"> <li>• Energy efficiency in water &amp; waste-water pumping</li> <li>• Managing GHG emissions from secondary &amp; tertiary treatment</li> <li>• Sludge disposal techniques</li> <li>• Reducing water supply variability &amp; losses from Climate Change</li> <li>• Integrated energy-water management</li> </ul>	<p><b>Incremental CC Mitigation Opportunities:</b></p> <ul style="list-style-type: none"> <li>• Collection &amp; utilization of landfill gas</li> <li>• Energy-efficient solid waste collection</li> <li>• Waste stream separation &amp; materials recovery</li> <li>• Local, city-wide, regional recycling schemes</li> <li>• Composting</li> </ul>	<p><b>Incremental CC Mitigation Opportunities:</b></p> <ul style="list-style-type: none"> <li>• Weatherization of buildings</li> <li>• Use of biofuels based on local feedstock</li> <li>• Additional lighting &amp; appliance efficiency initiatives</li> <li>• Selective use of renewable energy as economical</li> <li>• Use of sustainable building materials and products</li> <li>• Government procurement of energy-efficient goods &amp; services</li> </ul>

## Key findings

The degree to which climate change mitigation has been embraced in urban infrastructure assistance varies considerably.

Projects in solid waste management have made the most rapid progress in mainstreaming climate change mitigation opportunities, most recently through composting and recycling. The urban transport sector has also made noteworthy progress, particularly by incorporating regulatory and fiscal measures to reduce vehicular congestion and investment in clean and efficient transport infrastructure. Bus Rapid Transit (BRT) and investment in infrastructure for non-motorized transport (bicycles and pedestrian) are two examples of greenhouse gas (GHG) emissions-reducing components included in recent urban transport projects.

Water supply and sanitation and general urban infrastructure including buildings<sup>2</sup> seem to have the most unrealized climate change mitigation potential; however, the review found considerable regional variation. Some regions emphasized energy efficiency and integrated water-energy conservation strategies embedded within the assistance program, while other regions did not. Projects in regions with substantial heating loads served by imported fuels (ECA and EAP) were more likely to incorporate climate

change mitigation opportunities, including investment in improved thermal performance of buildings, rehabilitation of district heating schemes, and reform and improved management of heat utilities.

Increasingly, the overlap between adaptation measures and mitigation measures in the urban context will figure into future project design. For example, improving the energy efficiency of building construction (with improved insulation, reflective glass, or efficient air conditioning) will mitigate climate change by reducing GHG emissions while also rendering the urban infrastructure more adaptable to warmer weather conditions.

Consultations with urban practitioners revealed operational considerations for capturing additional climate change mitigation opportunities in future urban assistance projects. A key consideration is engagement with urban infrastructure specialists and country counterparts early in the project preparation process. In engaging with client countries it is vital to demonstrate that climate change mitigation can generate local co-benefits, and can contribute to general sector objectives and specific project development objectives.

## Operational considerations

Many urban practitioners are unfamiliar with the modalities of climate change mitigation in the urban sector; therefore, a

<sup>2</sup> This broad category includes social housing, municipal infrastructure such as hospitals and schools, and power and energy.

program of cross-support between the urban and environment networks would add value. In addition to familiarizing urban infrastructure practitioners with emerging climate change mitigation technologies and applications, a cross-support program would help codify the linkages between climate change mitigation and urban sector objectives. Typical linkages found in the review include: (i) high and increasing cost of oil (for non-oil producing countries), making oil dependency and urban infrastructure energy efficiency national concerns; (ii) local pollution abatement and congestion concerns, which if addressed by Non-Motorized Transport (NMT) or Transportation Demand Management (TDM), can yield global benefits as well; (iii) increased investment in infrastructure made possible by mobilizing GEF, UNFCCC, and CDM financing; and (iv) improved access to urban services such as affordable and reliable water supply and waste collection, and improved quality of human services made possible by rehabilitated urban infrastructure, such as adequately space-conditioned schools and hospitals.

### **Next steps**

A clear view of next steps emerged from the portfolio review process and consultations with urban practitioners. Practitioners stressed the importance of engagement at the Sector Board level and at the regional Sector Manager level as an essential first

step. Practitioners also recommended that the Environment Anchor formally engage the Urban Sector board in context and suggesting new initiatives (e.g., additional resources and operational guidelines) to make it happen.

Engagement at the Sector Board, Unit Director, and practitioner level must be followed by designating resources necessary to identify entry points for mainstreaming climate change mitigation in the regional and country-specific urban context. Finding workable climate change mitigation opportunities that deliver local as well as global benefits will require accelerated knowledge management efforts (e.g., a handbook on climate change mitigation measures and their local and global benefits); sector work (to match climate change mitigation modalities with urban sector priorities such as municipal finance, decentralization, land issues, housing and slum upgrades, cultural heritage, etc.); piloting efforts to demonstrate climate change-urban infrastructure linkages in specific projects; and analytic development (to create benchmarks/indicators that cities can use to identify opportunities and identify “good practice gaps” in urban infrastructure).

Specific follow-up activities suggested by urban practitioners and peer reviewers include:

- Preparation of guidance notes focused on capturing climate change mitigation

- opportunities in relatively under-served urban sub-sectors, notably water supply and sanitation and general infrastructure including buildings.
- Undertake a similar portfolio review focused on climate change adaptation opportunities in the urban context.
  - Collaborate with interested urban practitioners to pilot the key findings and guidelines in an operational setting.
  - Undertake analytical work needed to create climate change-related performance indicators that are relevant to city managers and allow for monitoring the effect of climate change mitigation measures over time.
  - Undertake analytical work in order to develop a co-benefits framework, which helps link climate change mitigation interventions to local benefits/priorities.



# 1

## INTRODUCTION

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### **The strategic context**

Reducing energy use and greenhouse gas (GHG) emissions in cities is fundamental to any comprehensive effort to slow the pace of global warming. Today, half of the world's population lives in cities, accounting for three-quarters of global energy use and greenhouse gas (GHG) emissions [1], and the trend toward urbanization is projected to continue over the next fifty years.

In the urban sector, an ideal climate change mitigation intervention should yield global benefits, especially GHG emissions reductions, at the same time that it contributes to sector and project development objectives. Examples include use of improved building materials and building envelope energy efficiency; improved energy efficiency in urban utilities, improved transport efficiency, sequestration and utilization of methane gas from landfills and waste water treatment, and cleaner primary energy supply and utilization.

Over the past decade, the World Bank has continually looked for ways to better integrate climate change considerations into its assistance and lending portfolios. Previous sector strategies articulating such an integrated approach include the 1999 Energy and Environment Strategy [2], 2001 Environment Strategy [3], 2002 Urban Transport Strategy [4], and Infrastructure Strategy [5]. In addition, the Bank's Energy, Transport and Water Department tracks on an annual basis the amount of assistance and lending in support of energy efficiency, renewable energy, and other GHG emission reducing technologies [6].

Nevertheless, with urban lending and assistance projects spread across a variety of operational sectors, the Bank has not yet developed a systematic approach to integrating climate change mitigation in its urban infrastructure projects. The recent integration of relevant sectors in the Sustainable Development Network (SDN) offers a real

opportunity to rethink how urban projects defined broadly might better internalize climate change mitigation. The Bank is also currently working on a Strategic Framework for Climate Change (SFCC) that will include a plan for scaling-up clean energy interventions through a set of new climate investment funds.

### **Goals and objectives of the study**

The goal of this study was to review the potential for mainstreaming climate change mitigation opportunities in urban infrastructure projects and to suggest directions for increased integration of climate change within the urban sector.

Specific objectives of the study included:

- Determining the extent to which climate change mitigation opportunities have been integrated into recently completed and ongoing urban assistance projects;
- Identifying climate change mitigation mainstreaming opportunities that could be supported in future projects;
- Identifying specific entry points (project development objectives, sector objectives, macroeconomic linkages) for mainstreaming climate change mitigation within urban projects;
- Highlighting examples of non-World Bank good practice for climate change mitigation in urban infrastructure;
- Developing an understanding of operational considerations to enhance integration of climate change mitigation in urban project preparation.

### **Methodology**

The study comprises three parts, each of which is reported in separate sections of this report: (i) a review of the Bank's urban portfolio from 1995–2005, document opportunities for climate change mitigation; (ii) a review of good practice outside the Bank for climate change mitigation targeted to urban infrastructure; and (iii) consultations with urban sector practitioners regarding practical aspects of incorporating climate change mitigation components within urban infrastructure projects.

## 2

# PORTFOLIO REVIEW PROCESS

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### **Time frame**

To understand how climate change mitigation opportunities have been included in mainstreaming urban projects historically and under current practice, the review included projects approved by the World Bank Board from FY 1995 through FY 2006.

### **Selection criteria**

Hundreds of World Bank projects have provided assistance and lending in the urban setting, but the portfolio review focused only on projects prepared by the five Sector Boards with a strong urban focus (Environment, Urban Development, Energy and Mining, Transport, and Water and Sanitation), and on projects containing any of 31 sector codes or 18 thematic codes determined to have an urban focus (See Table 2).

The portfolio review excluded all projects having climate change as a principal theme, including GEF projects and projects funded by carbon finance mechanisms and the Montreal and the Ozone Depleting Substance Protocols. This allowed a focus on opportunities for incremental inclusion of climate change mitigation components in mainstream urban projects.

### **Screening methodology**

Over 277 projects were implemented by the Urban Development, Environment, Energy and Mining, Transport, and Water and Sanitation Sector Boards between FY95 and FY06. For the portfolio review, after removing projects which contained GEF or other climate change components or which did not involve direct assistance to cities and municipalities, 171 projects

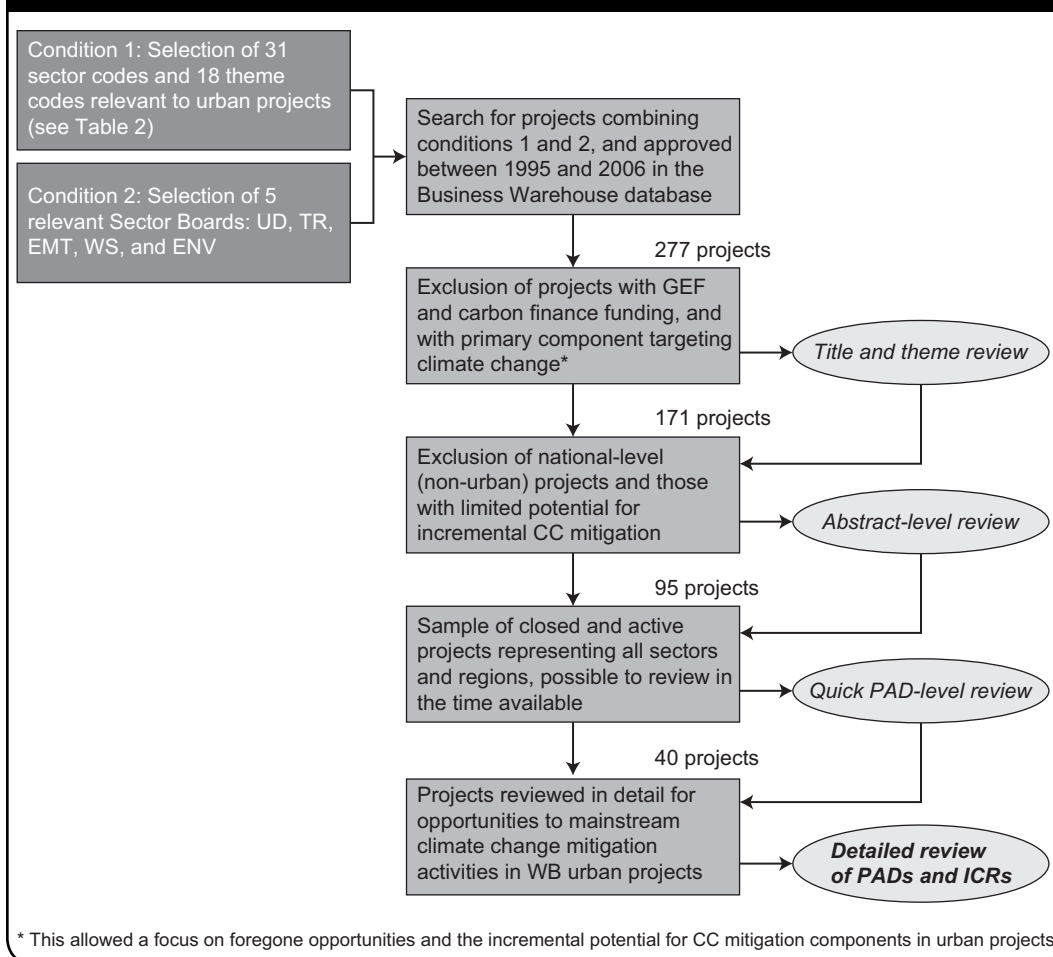
**Table 2: Listing of Urban-Related Themes and Sectors Used to Bound the Portfolio Review**

<b>Urban-Related Themes</b>		<b>Urban-Related Sectors</b>		
<b>Human Development</b>	<b>Urban Development</b>	<b>Public Administration, Law, and Justice</b>	<b>Education</b>	<b>Industry and Trade</b>
63 Child Health 65 Education 67 Health system performance 70 Other human development 89 Non-comm. Diseases/injury	71 Urban svcs/housing 72 Municipal finance 73 Municipal governance and institutions 74 Other urban	BC Central gov't administration BH Sub-national government administration BZ General	EP Primary education ES Secondary education ET Tertiary education EV Vocational training EZ General	YC Housing construction YW Other industry YZ General
<b>Financial and Private Sector Development</b>	<b>Environment and Natural Resources Management</b>	<b>Energy and Mining</b>	<b>Transportation</b>	<b>Water, Sanitation, and Flood Protection</b>
39 Infrastructure services for PSD 41 Small and medium enterprise support	81 Climate 82 Environ. policies 83 Land management 84 Pollution mgmt 86 Other	LA District heating and energy efficiency services LC Oil and gas LD Power LE Renewable energy LZ General	TV Aviation TP Ports, waterways and shipping TW Railways TA Roads and highways TZ General transportation	WD Flood protection WA Sanitation WS Sewerage WB Solid waste management WC Water supply WZ General
<b>Public Sector Governance</b>	<b>Social Development, Gender, and Inclusion</b>	<b>Information and Communications</b>	<b>Finance</b>	<b>Health and Other Social Services</b>
26 Decentralization	62 Other Social Development	CZ General information and communications	FC Housing finance and real estate markets	JA Health JB Social Svcs

were left for closer consideration (See Figure 1). Of this remainder, 95 projects were identified which represented the review's target population: city-focused infrastructure projects of all types across all regions, but lacking an explicit climate change mitigation component.

From these 95 projects which met the portfolio review criteria and reasonably covered all regions and all sectors, a final sample of 40 projects (21 active and 19 closed) was selected (See Table 3). A listing of the 40 projects is provided in *Annex 1*.

**Figure 1**  
**Selection Process for the Portfolio Review**



**Table 3: Distribution of Projects Selected for Review by Region and Sector Board**

<b>Project Category</b>	<b>Region</b>					
	<b>AFR</b>	<b>EAP</b>	<b>ECA</b>	<b>LCR</b>	<b>MNA</b>	<b>SAR</b>
Urban transport	1	2	1	3	0	1
Water Supply and Sewerage	1	4	2	1	1	1
Solid Waste Management	0	3	2	0	1	0
General Urban Infrastructure, including Power, Energy, District heat and Buildings	2	3	8	0	2	1



# 3

## OPPORTUNITIES FOR CLIMATE CHANGE MITIGATION IN THE URBAN PORTFOLIO

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### **Overall findings**

The portfolio review focused on four subsectors of urban operations: water supply and sewerage; urban transport; solid waste management; and general urban infrastructure (power, energy and buildings). Within these subsectors, the study explored three areas: current good practice project examples already in the portfolio; untapped opportunities for climate change inclusion in projects; and potential entry points and linkages to sector or project development objectives. These three areas are detailed below.

### **Good practice examples**

It was determined that a number of projects in the Bank portfolio sample set could serve as good practice examples of comprehensive inclusion of climate change mitigation opportunities. The Santiago Sustainable Transport and Air Quality Project (See *Box 1*) illustrates balanced attention to short-term transport systems improve-

ments while putting in place the increased capacity to plan additional longer-term improvements.

Similarly, there are also Water Supply and Sanitation (WSS) projects that demonstrate a comprehensive and nearly complete incorporation of climate change mitigation opportunities. *Box 2* describes the Yerevan Water and Wastewater Project in Armenia, which combines a range of energy efficiency improvements within an infrastructure rehabilitation project to yield improved reliability and affordability for customers and financial stability for operators.

In addition to the above, the study also identified other good practice examples (see *Box 3* (p. 23) on Tunisia Solid Waste Management Project and *Box 4* (p. 25) on the Tamil Nadu Urban Development Fund) of projects that could serve as reference points for teams designing new operations.

### **Box 1** **Sustainable Transport and Air Quality for Santiago (Chile)**

This project will help reduce greenhouse gases (GHG) from ground transport in Santiago by promoting shifts to more efficient and less polluting forms of transport, and by adopting sustainable, low-GHG transport measures. Components include; (i) promotion of bicycle use in peri-urban communities; (ii) evaluating clean technologies (hybrid diesel-electric, diesel, and CNG) for buses and improving the routing and public image of bus services; (iii) improved planning and institutional coordination within the sector; and (iv) detailed study of long-term options for improving public transport and reducing congestion, including integrating land-use and transport policies, engineering and regulatory studies for traffic calming measures in the city center; assessment of Congestion Pricing in Santiago; traffic optimization studies, and design of programs to package carbon emission reductions for Carbon Trading.

The project is in line with the CAS, as it will: (i) enhance economic growth and social progress by making the city more appealing and favoring a larger effective labor market; (ii) heighten the inclusion of vulnerable groups, by providing improved urban mobility at affordable prices and reasonable travel times; (iii) improve urban environmental conditions which primarily affect the poor; (iv) promote public private partnerships through a renovated concession mechanism for private operators to provide public transport services; and (v) build capacity within key public agencies.

Key outcomes include stabilizing the modal share of public transport, reducing carbon intensity of average urban trips, introducing land-use policies that favor reduction in average trip length, removing barriers to clean transport technologies, increasing bicycle and pedestrian modal shares, and improving urban air quality.

*Source:* World Bank Documents

### **Box 2** **Yerevan Water and Wastewater Project (Armenia)**

Yerevan is the capital city of the Republic of Armenia. This \$20 million IDA-financed project will continue improvements in Yerevan's water and wastewater services focused on reducing environmental pollution, providing continuous water supply at affordable cost, transitioning to private operation and management of the service provider, and establishing conditions for financial stability of water and wastewater utilities.

The project supports the CAS goals of: (i) reducing non-income poverty by ensuring access to basic urban infrastructure; and (ii) removing the financial constraints to infrastructure investment and service improvement.

Lending will create the Yerevan Water and Wastewater Fund, which will invest in energy efficiency measures to make water and wastewater services more affordable, such as diverting water production from pumped to gravity water resources, reducing unaccounted for water through distribution system improved monitoring and rehabilitation, and phasing out old, inefficient pumping plants.

System reliability and control, enabling safe, continuous water supply by rehabilitating storage capacity in water distribution pressure zones; realigning transmission mains in areas prone to landslides; improving distribution system water flow transferability to enable supply from different water sources.

Environmental pollution is addressed with a wastewater component which rehabilitate wastewater collectors overflow chambers, and pumping stations to reduce uncontrolled discharges into water courses.

*Source:* World Bank Documents

### **Untapped opportunities for climate change inclusion in projects**

Significant unrealized opportunities for climate change mitigation were found of the projects reviewed. The incremental climate change mitigation potential varied across types of urban infrastructure and according to the nature of the assistance, the project development objectives, and macroeconomic considerations of each client country. The broadest spectrum of unrealized climate change mitigation opportunities was found in two sectors: Water Supply and Sanitation and General Urban Infrastructure, including Power, Energy, District Heat & Buildings. In terms of absolute magnitude, however, the greatest potential may be in the Urban Transport sector (because of the growing scale of vehicular GHG emissions) and Solid Waste Management (including recycling and composting in addition to landfill gas recovery and utilization).

### **Potential entry points and linkages to development objectives**

An entry point exists whenever integration of climate change mitigation can be shown to contribute to the broader development or macroeconomic issues or objectives of the client country. The portfolio review identified potential entry points and linkages to sector or project development objectives that would help mainstream inclusion of climate change mitigation. The review found numerous instances where incremental climate change mitigation opportunities could contribute to meeting the project

development objectives (See Table 4). Examples of linkages to development objectives or macroeconomic pillars include:

- When energy efficiency or water loss reduction measures reduces delivery costs of essential urban services, making them more affordable and accessible to the urban poor;<sup>3</sup>
- When local recycling or solid waste stream separation generates local income and jobs;<sup>4</sup>
- When additional arrangements for non-motorized transport (bicycle or pedestrian) reduces congestion and air pollution from short-duration trips;<sup>5</sup>
- When improved thermal performance of buildings reduces expenditure on heating and cooling public buildings and creates an indoor environment where essential health and education services can be more effectively delivered.<sup>6</sup>

The review's findings by subsector are detailed in the following section.

## **Subsector Review**

### ***Urban transport***

Urban transport projects cover a wide range of investment and assistance supporting an even broader range of urban transport

<sup>3</sup> Project Appraisal Document on a proposed loan to Ukraine for a Lviv Water and Wastewater Project

<sup>4</sup> Project Appraisal Document on West Bank and Gaza Solid Waste and Environmental Management Project

<sup>5</sup> Project Appraisal Document on China Guangzhou City Center Transport Project

<sup>6</sup> Project Appraisal Document on Belarus Social Infrastructure Retrofitting Project

**Table 4: Opportunities for Incremental Climate Change Mitigation in Different Subsectors that also Contribute to Meeting Project Development Objectives (Based on the Portfolio Review)**

<b>Development Objectives</b>	<b>Subsectors</b>			<b>General Urban Infrastructure (incl. Power, Energy &amp; Buildings)</b>
	<b>Urban Transport</b>	<b>Water Supply &amp; Sewerage</b>	<b>Solid Waste Management</b>	
Access to Urban Services	✓	✓	✓	✓
Conserving Finite Resources & Improving Resource Management		✓	✓	
Financially Sustainable Urban Services	✓	✓	✓	✓
Improving Service Quality & Affordability	✓	✓	✓	✓
Livelihood Improvement & Poverty Reduction	✓	✓		
Mitigating Environmental Damage	✓	✓	✓	✓
De-centralizing services provision & building local capacity		✓	✓	
Sustainable Urban Development	✓	✓	✓	✓

infrastructure, from pedestrian access to public transport services and mixed-mode urban transport systems including road and rail. The World Bank's Urban Transport Sector Board provides a network for understanding complex, multi-modal urban transport linkages and issues and addressing country- and city-specific situations, within an overall program of advisory and lending assistance. Urban transport project components typically include lending in support of improved public transportation services, promotion of vehicle fleets meeting local emissions standards or operating on clean fuels, support for non-motorized transport, and capacity building to plan for and manage increasing motorization and road congestion. Lending and other assistance which improves urban

transport conditions and indicators (e.g., access to public transport, road congestion, trip length and duration, local air pollution) implicitly reduces both local air pollution and global climate change.

Eight urban transport projects were included in the portfolio review, including three closed and five active projects spread across all regions except the Middle East and North Africa (MNA). Typical components included Highway Construction; Urban Bus Fleets; Improved Pedestrian Access; Improved Signage, Crossings, Traffic Safety; Mass Transit Systems; and Modal Integration (See Table 5).

As expected, all of the eight projects were already focused on improving public

**Table 5: Urban Transport Project Components and Incremental Climate Change Opportunities**

<b>Urban Transport</b>	
<b>Typical Components</b>	<b>Incremental CC Mitigation Opportunities</b>
Highway Construction	Integrated Transportation and Land Use Planning
Urban Bus Fleets	Bus Rapid Transit and better integration of buses with other transport modes; Vehicle Emissions Inspections
Improved Pedestrian Access, Signage, Crossings, Traffic Safety	Streetlighting
Mass Transit Systems	Vehicle fleet renewal with high-efficiency clean vehicles
Modal Integration	Transportation Demand Management
	Fiscal & tax regimes, including parking charges, congestion charges & progressive taxes on engine size
	Non-Motorized transport (dedicated bike & pedestrian paths) integrated with motorized modes
	Use of Intelligent Transportation Systems (ITS) where possible to increase transportation efficiency

transport services, especially for the poor, increasing the modal share of non-motorized transport, and reducing traffic congestion and travel times, all of which provide both local and global environmental benefits.

Nevertheless, the portfolio review identified seven opportunities for climate change mitigation which were not included in the projects reviewed. These are:

- improved air quality and reduced fuel use through renewing public and private vehicle fleets (e.g., buses and jeepneys);<sup>7</sup>

- support for vehicles operating on alternative fuels;
- setting and enforcing stricter emissions standards for motor vehicles, including vehicle inspection and maintenance programs;
- promotion of non-motorized transport (bicycles and walking) through dedicated infrastructure (bike paths and walkways) and more-effective modal integration with public transport;
- improved amenities, decreased travel time, and higher per-passenger fuel efficiency via dedicated, high-quality public transport schemes (Bus Rapid Transit);
- regulatory and fiscal transportation demand-management policies, such as parking charges reflecting true land prices especially in congested areas, excise or import taxation according to engine

<sup>7</sup> A recent review of World Bank urban transport projects mentions that improved operation of diesel buses in Rio de Janeiro resulted in an annual saving of 40 million liters of fuel (a 12.5% reduction), averting 107,800 tons of CO<sub>2</sub> emissions per year. See *Promoting Global Environmental Priorities in the Urban Transport Sector*, World Bank Group, 2006.

**Table 6: Linking Climate Change Opportunities to Development Objectives - Urban Transport**

<b>Project Name</b>	<b>Country</b>	<b>Included Climate Change Opportunities</b>	<b>Incremental Climate Change Opportunities</b>	<b>Sector or Project Development Objectives</b>	<b>Climate Change Mitigation-PDO Linkage</b>
Urban Mobility Improvement Project	Senegal	Integrating transport modes that make public transport more attractive and pedestrians safer	Procure mini-buses with higher fuel economy & lower emissions	Safe, environmentally sustainable and financially viable urban transport sector	High-efficiency minibuses cheaper and cleaner to operate
Buenos Aires Urban Transport Project	Argentina	Improved pedestrian corridors, bikepaths, traffic management, bus and jeepney rapid access, capacity building for urban transport planning	Consider other transport efficiency improvement modalities, such as traffic demand management and other regulatory measures	Reform and rehabilitate the urban transport infrastructure in order to reduce congestion, increase traffic safety, and reduce air pollution	Regulatory measures & TDM will decrease the number of vehicles accessing the urban center
São Paulo Metro Line 4 Project	Brazil	New METRO line reduces congestion and improves transport efficiency	Energy efficient construction/ operations of rail/ bus terminals; Pilot low-emission or alternative-fuel buses within feeder bus network	Improve the accessibility of the low-income population to affordable and quality transport, while maintaining the financial sustainability of the urban transport sector	Alternative fuel buses cheaper to operate & have better energy security relative to imported oil

size, and usage or access fees for roads or downtown areas; and

- application of Intelligent Transportation Systems (ITS) to achieve greater efficiency in transportation, especially in alleviating congestion.<sup>8</sup>

<sup>8</sup> Intelligent Transportation Systems (ITS) combine computer modeling, centralized control, and advanced surveillance systems to dynamically detect and alleviate traffic bottlenecks through re-routing and active control of traffic signs and signals.

It is important to ensure that applied climate change mitigation opportunities also make a material contribution to the project's core development objectives. Table 6 provides examples from three of the projects reviewed which illustrate how selected climate change mitigation opportunities contribute to mainstream project or sector objectives.

The review suggests that mainstreaming incremental climate change opportunities in urban transport projects is straightforward,

because transport-related issues such as congestion, air quality, urban quality of life, and safety are urban sector priorities and rank high in both the Bank's Country Assistance Strategy (CAS) and the country's Poverty Reduction Strategy (PRSP). In the Buenos Aires Urban Transport Project, for example, improved energy efficiency in subway construction and increased capacity in the Urban Transport Planning Agency are positive contributions to the project's development objectives. A project in Senegal, demonstrated that replacing the public transit vehicle fleet would contribute to a safer and more environmentally sustainable urban transport sector, while going further to procure energy efficient and low-emissions feeder buses could improve the accessibility of the poor to affordable and quality transport.

### ***Water supply and sanitation***

Improving water supply and sanitation (WSS) is a key element of the World Bank's commitment to reducing poverty and attaining the Millennium Development Goals. With a project portfolio of almost \$7 billion, the World Bank is the largest external financier of WSS projects and is a recognized leader in terms of sector knowledge and analytics and development of comprehensive strategy and policy for the sector. The World Bank's WSS practitioners work closely with national and local governments, as well as civil society and local entrepreneurs, using a comprehensive approach focused in four areas:

- Extending WSS services to the urban poor;
- Improving operator performance;
- Increasing rural access to sustainable WSS; and
- Better managing the water resource base.

Urban WSS projects typically focus on improving infrastructure for and delivery of potable water, storm drainage, and sanitation, and providing a broad range of assistance to public and private WSS operators. Typical components of a WSS project (See Table 7) include water supply, storage, treatment and distribution networks; capacity building and institutional reform; sewage and storm water collection, treatment and disposal facilities; and water supply and sewerage connections and kiosks. Many WSS projects incorporate climate change mitigation through components to enhance the efficiency of water supply, by installing new or rehabilitated pumping equipment and reducing unaccounted-for (lost and stolen) water.

Ten urban WSS projects were reviewed, including five closed and five active projects representing all six regions. Incremental climate change mitigation opportunities are shown in Table 7 and linkages with development objectives for several active projects are shown in Table 8. As with the urban transport sector, it was possible to identify several strong linkages between additional climate change mitigation and sector and

**Table 7: Urban WSS Project Components and Incremental Climate Change Opportunities**

<b>Urban Infrastructure - Water Supply &amp; Sanitation</b>	
<b>Typical Components</b>	<b>Incremental CC Mitigation Opportunities</b>
Water supply, storage and treatment facilities	Energy efficiency in water & wastewater pumping
Secondary and tertiary distribution networks	Managing GHG emissions from sewage treatment
Capacity building for WSS operators	Reducing water supply variability & losses
Institutional reform	Integrated energy-water management
Loss reduction	
Sewage collection, treatment and outfall facilities	
Water supply and sewerage connections	
Water pressure and quality monitoring systems.	

**Table 8: Linking Climate Change Opportunities to Development Objectives - Urban WSS**

<b>Project Name</b>	<b>Country</b>	<b>Included Climate Change Opportunities</b>	<b>Incremental Climate Change Opportunities</b>	<b>Sector or Project Development Objectives</b>	<b>CC Mitigation PDO Linkage</b>
OSE Modernization	Uruguay	Unaccounted for Water Reduction Program	Integrated water-energy management; GHG capture in sewage sludge treatment and disposal	Lagging competitiveness in public utilities; Reform of public enterprises	Savings from integrated management plus carbon revenue flow will improve water utility competitiveness & accelerate privatization
Lviv Water & Wastewater Project	Ukraine	Rehabilitation of pumping stations, reduction of leakage through pipeline replacement	GHG capture from sludge treatment	Financial sustainability of local gov't	Lagoon gas capture will create a carbon revenues stream to offset the cost to municipalities of providing these services
Ahwaz & Shiraz Water Supply and Sanitation Project	Iran	Rehabilitation and improvement of water supply and sewerage infrastructure	Additional energy efficiency and GHG mitigation measures	Enhance quality of life for the urban poor	Service delivery cost savings from EE + carbon revenue streams will keep WSS services affordable

project objectives. For example, in the Uruguay OSE<sup>9</sup> Modernization Project, incremental electricity cost savings from in-

tegrated water-energy management will contribute directly to the reform process for water supply and wastewater services providers. The Ukraine/Lviv Water/Wastewater Treatment Project already largely incorporates the climate change mitigation opportunities shown in Table 8. Similar projects in

<sup>9</sup> Obras Sanitarias del Estado (OSE) is a state-owned water utility established to supply water and sanitation for the entire country, except for Montevideo, where sewerage is provided by the City of Montevideo.

the future could incorporate additional GHG emission reductions from sewage treatment and disposal, including methane gas capture and use, thereby contributing to more financially sustainable provision of urban wastewater services.

Most of the reviewed projects included components to enhance the efficiency of the water and wastewater sector, through the installation of new or rehabilitated pumping equipment and reduction of water losses due to leakages in the delivery system. While these measures are specified on the water supply and distribution side, there is little corresponding attention to improving efficiency in wastewater treatment and sewage pumping and the management of GHG emissions from treatment lagoons or sludge treatment and disposal. Also noteworthy within the WSS sector are incremental opportunities for climate change adaptation, especially addressing variable water supply due to reduce seasonal run-off, aquifer depletion, or increased evaporation.

### ***Solid waste management (SWM)***

The World Bank Group has a portfolio of 85 active “urban environment” projects with \$3.5 billion in loan and grant commitments. Solid waste management (SWM) is the main component in more than half of these projects. Another 20 projects with large SWM components are under preparation within the Urban Environment pipeline, with a total projected value of \$4.5 billion.

Pillars of the Bank’s SWM portfolio include supporting comprehensive and strategic planning by local governments; helping cities rationalize operator performance while expanding services to growing urban populations; supporting community participation in planning, siting, and operations; encouraging private sector involvement; and mobilizing new funds (such as the Prototype Carbon Fund and the Climate Investment Fund) for GHG emissions reduction.

SWM components typically focus on collection, treatment and disposal of solid wastes, mainly municipal refuse, and capacity building of both local governments (for planning) and operators (for improved management). Incremental climate change mitigation opportunities beyond the nearly-mainstreamed landfill gas capture include incremental recycling opportunities (See Table 9), plus improvements in the energy efficiency of collection (e.g., fuel-efficient vehicles) and comprehensive (city-wide) recycling programs.

The portfolio review examined a total of six projects, three closed and three active, across three regions. Of the six, two projects, along with their incremental opportunities for climate change mitigation and potential entry points for mainstreaming within sector and project development objectives, are shown in Table 10. The Shanghai Urban Environment Project is indicative of the incremental climate change mitigation

**Table 9: Urban SWM Project Components and Incremental Climate Change Opportunities**

<b>Solid Waste Management</b>	
<b>Typical Components</b>	<b>Incremental CC Opportunities</b>
Establishing & managing sanitary landfills	Collection & utilization of landfill gas
Establishing and operating municipal waste collection schemes	Energy-efficient solid waste collection
Local recycling schemes	Waste stream separation & materials recovery
Capacity building of municipal solid waste operators	Local, city-wide, regional recycling schemes
Encouraging proper waste disposal practices	Composting
Regulating dumpsites/informal disposal operations	

**Table 10: Linking Climate Change Opportunities to Development Objectives - SWM**

<b>Project Name</b>	<b>Country</b>	<b>Included Climate Change Opportunities</b>	<b>Incremental Climate Change Opportunities</b>	<b>Sector or Project Development Objective</b>	<b>CC Mitigation PDO Linkage</b>
Solid Waste and Environmental Management Project	West Bank and Gaza	Improved MSW collection & disposal, including landfill gas recovery	Possibility of carbon finance for landfill gas to supplement operating budgets & awareness campaigns; local recycling to reduce waste stream volumes & create jobs	Strengthening of institutions, arresting emerging pollution and protection of scarce natural resources	Incremental carbon revenue stream contributes to institutional strengthening, recycling extends useful life of scarce landfill space
Shanghai Urban Environ	China	Carbon finance of sludge disposal	Integrated water-energy management	Financially sustainable urban svcs provision	Reduced energy costs contribute to financial viable of wastewater services provider

opportunities, such as integrated water-energy management practices for the waste water portion of the project, thus reducing overall sewerage costs and rendering the urban services providers more financially viable.

There are also good practice examples of comprehensive inclusion of climate change mitigation opportunities for urban solid waste management projects. The Tunisia Municipal Solid Waste Management project

### Box 3 Municipal Solid Waste Management (Tunisia)

This \$27 million IBRD-financed project assists the Tunisian Government in developing the key elements of environmentally and financially sustainable municipal solid waste management. The project includes assistance to improve solid waste management at the national and local levels and rehabilitation of environmentally harmful dumpsites into modern landfills with biogas collection and utilization capacity. These actions will enable the Tunisian Government to access additional revenue through the Clean Development Mechanism (CDM), thus improving cost recovery for the SWM sector. Institutional Support and Capacity Building will support the establishment of national coordination of the SWM sector plus a decentralized municipal solid waste management system at the regional and inter-municipal level focused on introducing modern SWM management as well as measures to achieve cost optimization and cost recovery.

The project will finance construction of a 5th cell in the Djebel Chekir landfill (largest landfill in Tunisia), including the construction, and operation of a biogas management system and nine new landfills in Bizerte, Nabeul, Sousse, Monastir, Kairouan, Sfax, Gabes, Jerba and Medinine designed along the principles of sustainable management of municipal solid waste.

Project outcomes include institutional strengthening of the sector, policy instruments for sustainable waste management, introduction of a national cost recovery system; outreach and communication to change citizens' behaviors, and incremental revenue generation from reductions in greenhouse gas emissions.

*Source:* World Bank Documents

(See *Box 3*) is a good example of blended IBRD/carbon finance operation<sup>10</sup> which will quickly replicate good practice in landfill management on a sub-national and then national scale.

#### **General urban infrastructure and buildings**

This category, which includes power, energy, district heat, and social housing and buildings, contains a broad spectrum of projects focused on urban buildings and facilities and on providing them with energy services, primarily heat and electricity. Typical components include: construction/rehabilitation of district heating facilities;

assistance to capacity building of municipal facilities including heat utilities; expansion of electricity distribution networks and capacity building for electricity providers; retrofitting of public buildings for energy efficiency; replacement of boilers and other equipment; and construction/rehabilitation of social housing and municipal buildings.

Projects in this category showed considerable variability by region in the extent to which they addressed climate change mitigation opportunities. Projects in countries with substantial heating needs (mainly in ECA) were found to be fairly comprehensive in addressing energy efficiency and climate change mitigation opportunities.

<sup>10</sup> term used for carbon credits to help finance GHG.

There is, however, scope to introduce greater efficiency on the demand side, i.e., at the end user level, with investments in weatherization of residential and commercial buildings, and the use of building materials and technologies that increase the energy efficiency of the building envelope (See Table 11).

Observed entry points for climate change mitigation in this sector included reduction of fiscal drain from municipal budgets, providing for the minimum infrastructure necessary to deliver essential human services, improving access to urban services, and devolvement of authority, capacity and

financial resources to local government bodies (See Table 12).

There are many good practice examples of a more comprehensive treatment of climate change mitigation opportunities within the context of general urban infrastructure, especially municipal buildings and facilities. The Third Tamil Nadu Urban Development Project (See *Box 4*) is a good example of an IDA operation which seeks to incorporate climate change mitigation opportunities within an overall framework of municipal renovation together with improved municipal capacity to maintain these improvements in a sustainable way.

**Table 11: General Urban Infrastructure Components and Incremental Climate Change Opportunities**

<b>Power/Electricity/District Heat/Buildings</b>	
<b>Typical Components</b>	<b>Incremental CC Opportunities</b>
Steam or hot water production and distribution facilities	Weatherization of buildings
Capacity building of district heating providers and heat sector reform	Development of biofuels based on local feedstock for use in buildings and facilities
Heat metering and demand management equipment	Additional lighting & appliance efficiency initiatives
Retrofitting of public buildings for energy efficiency	Government procurement of energy-efficient goods and services
Replacement of boilers and other equipment	Selective use of renewable energy as economical Use of sustainable building materials & product

**Table 12: Linking Climate Change Opportunities to Development Objectives for General Urban Infrastructure**

<b>Project Name</b>	<b>Country</b>	<b>Included Climate Change Opportunities</b>	<b>Incremental Climate Change Opportunities</b>	<b>Sector or Project Development Objective</b>	<b>CC Mitigation PDO Linkage</b>
Small Towns Infrastructure and Capacity Building Project	Kyrgyz Republic		Incorporate energy efficiency into various urban infrastructure improvements, from street lighting to new water distribution systems	Decentralize provision of urban and social infrastructure improvements and build capacity of Local Self-Government (LSG)	Reduced operating costs through energy savings will contribute to devolution and provide additional resources for LSGs
Third Tamil Nadu	India	Improve technical capability, performance & financial sustainability of agencies responsible for urban services	Build climate change management into capacity building & training for urban managers; create dedicated carbon subproject preparation facility to identify subproject for CDM funding	Devolve responsibility and capacity for financing and providing urban services to Urban Local Bodies (ULBs)	Carbon revenue streams will provide incremental financing & possible public-private partnerships for ULBs
Croatia District Heating	Croatia	Reduction of heat and water losses through rehabilitation of district heating networks	Installation of heat metering and additional heat conservation & demand management	Reducing GHG in preparation for EU accession	Reduced energy requirements will help meet strict EU standards for thermal performance of buildings
Power Access and Diversification	Djibouti	Wind farm, T&D loss reduction	Household CFL program, integrated water-energy mgmt	Affordable and accessible energy services	CFLs help minimize electricity bills and reduce oil import needs

**Box 4****Third Tamil Nadu Urban Development Project (TNUDP III) (India)**

Tamil Nadu Urban Development is a \$30 million IDA-financed repeater project consisting of an Urban Investment component focused on developing sustainable urban investments such as water supply, waste water collection, solid waste management, storm water drains, and sanitation facilities, and an Institutional Development component providing support for management improvements and institutional changes that contribute to the sustainability of urban policy reforms, organizational performance, and urban services delivery. This project includes a project preparation facility focused on incorporating innovative “clean energy” concepts into a program of sustainable urban investments.

*Source:* World Bank Documents.



## 4

# REVIEW OF NON-WORLD BANK GOOD PRACTICE IN URBAN CLIMATE CHANGE MITIGATION

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As the second part of the desk study, staff undertook a review of urban-focused climate change mitigation initiatives outside the World Bank, and identified a large and growing volume of good practice from which World Bank practitioners can learn. There are also numerous networks and associations focused on climate action in the urban context with which the World Bank is already actively collaborating. The summary below highlights elements which are potentially useful in considering how to scale up climate change mitigation interventions in World Bank urban infrastructure projects.

### **Networks for urban climate change mitigation**

There are many formal and informal networks dedicated to documenting and replicating climate change mitigation activities

by city governments. Organizations actively promoting and coordinating such activities include the International Energy Agency, the United Nations, bilateral donors such as USAID and SIDA, and NGOs. Table 13 provides a list of some of the better-known urban climate change action networks.

The World Bank cooperates with or has worked with many of these networks. The World Resource Institute EMBARQ program has participated in developing several urban transport assistance projects ultimately financed by the Bank, including the Mexico City BRT project and projects in Lima, Peru, and Santiago, Chile. The Bank's Latin America and Caribbean Vice Presidency (LAC) is working with The Climate Group in the UK to develop urban indicators to measure the GHG "footprint" of large cities.

Table 13: International Organizations and Associations Focused on Urban Climate Change Action

<b>Network</b>	<b>Sponsorship</b>	<b>Goal or Objective</b>	<b>Signature Activities</b>
ICLEI (International Council for Local Environmental Initiatives) <sup>11</sup>	ICLEI's World Secretariat is hosted by the City of Toronto	ICLEI helps localities increase awareness of sustainability issues and plan and implement action toward concrete climate targets.	ICLEI helps participating local governments establish and implement sustainable development through a five-step process: (1) establish baselines; (2) set targets; (3) develop plans; (4) implement; and (5) measure results.
Low Carbon Leaders: C40	The Climate Group (U.K.) <sup>12</sup>	Mobilizes municipal leaders to undertake climate change mitigation and information sharing	<ul style="list-style-type: none"> <li>• Cities Climate Summits (Oct. 2005 and May 2007)</li> <li>• Establishment of the London Climate Change Agency</li> </ul>
Municipal Network for Energy Efficiency (MUNEE) <sup>13</sup>	Alliance to Save Energy/USAID	Assists Eastern European and Eurasian municipalities in implementing energy-efficiency improvements in heating and water systems, residential structures, and municipal buildings.	<ul style="list-style-type: none"> <li>• Policy and tariff reform,</li> <li>• Disseminating energy management best practices</li> <li>• Energy planning &amp; energy management techniques</li> <li>• Watergy is active in India, Mexico, Brazil, Philippines, Sri Lanka, and South Africa.</li> <li>• Toolkits provide manuals, case studies, best practice guides, and resource documents.</li> </ul>
Watergy Network	Alliance to Save Energy/USAID <sup>14</sup>	Helps cities realize energy, water and monetary savings through technical and managerial changes in water supply systems	
Partnership for Sustainable Urban Transport in Asia <sup>15</sup>	SIDA, ADB, EMBARQ	Helps cities respond to the uncontrolled growth of urban motorized transport, which threatens air quality, increases congestion, and creates poor road safety conditions.	PSJTA encourages city governments to improve transport system sustainability, through international cooperation.
Energy Efficiency 21	UNECE (UN Economic Commission for Europe)	Assists SE and Eastern Europe, Caucasus, and Central Asia countries in enhancing energy efficiency, diminishing fuel poverty arising from economic transition and meeting international environmental treaty obligations.	Develops capacity at the local level for energy efficiency and renewable energy investment, including promoting energy efficiency markets
MEELS <sup>16</sup>	IEA DSM Program Annex 9	Documents the role of municipalities as owner, operator, regulator, and customer of urban infrastructure, including good practices in taking energy efficient actions.	Case studies in good practice of municipalities in undertaking energy efficiency

<sup>11</sup> <http://webstore.iclei.org>

<sup>12</sup> *Low Carbon Leader: Cities*. <http://theclimategroup.org>

<sup>13</sup> <http://www.munee.org/>

<sup>14</sup> *Watergy: Taking Advantage of Untapped Energy and Water Efficiency Opportunities in Municipal Water Systems*, prepared by the Alliance to Save Energy for USAID, 2002. <http://www.watergy.net/resources/publications/watergy.pdf>

<sup>15</sup> *Sustainable Urban Transport in Asia: Making the Vision a Reality*. A CAI-Asia Program. Jan. 2007. [http://www.wri.org/climate/pubs\\_description.cfm?pid=4268](http://www.wri.org/climate/pubs_description.cfm?pid=4268)

<sup>16</sup> *Municipalities and Energy Efficiency in a Liberalized System (MEELS) – The Role of Municipalities in the Energy Sector*. Final Report of Annex IX of the IEA Demand Side Management Program. October 2002. <http://dsm.iea.org/Files/Exco%20File%20Library/Key%20Publications/GrazReport2Final.pdf>

## Urban transport

There are many examples of good practice in realizing climate change opportunities within urban transport projects, mostly focused on Bus Rapid Transit (BRT), Non-Motorized Transport (NMT), and Transportation Demand Management (TDM). Good practice examples in developed countries (Korea, US, Canada, UK) include a fee-based approach in London, England, where revenues from a downtown congestion charge are used to support bus transport, taxi fleet renewal, and other clean transport mechanisms. Since introduction in 2003, traffic in the central zone has been reduced by 15%, with more than £170 million in congestion charge revenues invested in bus network improvement such as new bus lanes and improved signaling arrangements.<sup>17</sup>

The review also found several notable examples of good practice in China, Colombia, Mexico, and Argentina (See Table 14). Of particular note is the integrated approach to managing transport-related downtown congestion and pollution in Bogota, Colombia, where a combination of bike lanes, pedestrian promenades and BRT has resulted in significant GHG emission reductions along with the mainstream urban transport indicators (local pollution, downtown congestion, long travel times, urban quality of life, and safety).

<sup>17</sup> The Climate Group, Case Studies. Available at: [http://theclimategroup.org/index.php/reducing\\_emissions/case\\_studies/](http://theclimategroup.org/index.php/reducing_emissions/case_studies/). Last accessed on March 25, 2007.

## Water supply and sanitation

Many good practice examples from outside the Bank can also be found for the water supply and sanitation sector (See Table 15). For example, a considerable amount of donor-supported work has been done under the auspices of the USAID-sponsored Municipal Network for Energy Efficiency (MUNEE), through which efforts in Eastern Europe and Central Asia have helped implement a combination of water sector reforms, integrated water-energy management, capacity building, automation and advanced technologies for water storage and supply, and legacy distribution network remediation. Several of these projects involved rehabilitation of older distribution networks, resulting in enormous savings of water and energy plus vastly improved reliability and quality of supply.

Another water and waste water network delivering good practice in climate change mitigation is the “Watergy” activity carried out by the Alliance to Save Energy and supported by several donors, including USAID, throughout Latin America, Africa and South Asia. In Veracruz, Mexico, for example, application of GIS mapping techniques together with hydrological modeling allowed for significant increases in the operational efficiency of a water supply system reliant on well water and diurnal above-ground storage. The ability to optimize water pumping and storage against hourly water requirements plus improved controls and

Table 14: Good Practice Examples of Climate Change Mitigation in Urban Transport Projects<sup>18</sup>

<b>Country</b>	<b>Project Title</b>	<b>Climate Change Mitigation Components</b>	<b>Key Drivers</b>
<b>China</b>	Guangzhou Pedestrian Mobility/Motorcycle Ban	Pedestrian-oriented streets and downtown motorcycle bans reduce noise, pollution, parking and driving on walkways, encouraging pedestrian travel	Crime, noise, downtown pollution, congestion
<b>Colombia</b>	Bus Rapid Transit (BRT), Non-Motorized Transport (NMT) and Traffic Demand Management (TDM) in Bogota <sup>18</sup>	Bogota has implemented numerous GHG emission reduction measures. The City has built 200km of bike lanes and sidewalks, shaded promenades, and a 17 kilometer pedestrian zone to encourage NMT. TDM measures include alternating odd-even car access within Bogota, doubling parking fees, increased gas taxes, and barriers preventing illegal parking. The combined GHG emission effect was estimated at 318 metric tons per day from 1997 levels.	Pollution, congestion, long travel times, improved urban quality of life, safety, crime
<b>China</b>	Median Bus Lanes and Bus Rapid Transit in Kunming <sup>18</sup>	Kunming's newly-established Urban Transportation Institute planned and implemented a 20 km median bus lane BRT system which accommodates not only buses but also bicycles and pedestrians.	Congestion, long travel times, pollution, high fuel consumption
<b>Korea</b>	Bus Rapid Transit and Sector Regulation in Seoul <sup>18</sup>	Seoul's BRT project included new 'clean' bus fleets, new contracting arrangements with bus operators, 75 km of median bus-only lanes including cut-outs at bus stops, bus management systems using GPS technologies, Extensive marketing and promotional activities, and modern bus stations with improved amenities.	Increasing car ownership and congestion, declining bus system rider-ship, and bus operator profitability.
<b>Mexico</b>	BRT, diesel bus conversion, and NMT in Mexico City	The Center for Sustainable Transport planned a BRT system running along 14 km of the central Insurgentes Avenue transport artery. The BRT carries more than 100 million passengers and prevented an estimated 36,000 tons of CO2 emissions in its first year. An associated pilot project retrofitted Mexico City's diesel buses with catalytic converters and diesel particulate filters, reducing soot emissions from old and new buses.	Local pollution, congestion, safety, travel times
<b>Argentina</b>	NMT in Buenos Aires <sup>19</sup>	Since 2003, the City of Buenos Aires has expanded a bicycle network including 164 km exclusive lanes, and another 400 km of shared lanes, allowing cyclists to commute to the city and getting motorized transportation off the road. Some 240,000 bicycle trips substituted for private car or public transport in 2003, avoiding 4,000 tons of CO2 and significant amounts of local air pollutants.	Congestion, travel times, local pollution

<sup>18</sup> Clean Air Institute for Asian Cities – Innovative Practices. [http://www.cleanairnet.org/caasia/1412/articles-60116\\_innovative.pdf](http://www.cleanairnet.org/caasia/1412/articles-60116_innovative.pdf)

<sup>19</sup> ICLEI. 2006. International Progress Report on "Cities for Climate Protection." Available at: [http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP\\_International\\_Report-2006.pdf](http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP_International_Report-2006.pdf).

Table 15: Good Practice Examples of Climate Change Mitigation in Water Supply and Sanitation Projects

<b>City/Country</b>	<b>Project Title</b>	<b>Description</b>	<b>Key Drivers</b>	<b>Metrics &amp; Indicators</b>
<b>Tirgu Mures, Romania</b>	Reducing distribution losses in municipal water supply <sup>20</sup>	Water loss audit + leak monitoring + leak detection & remediation for an older distribution network	Reduced pressure on water supplies; low capacity of local utility; lower operating costs	Aquaserv losses were cut by 1/3, + electricity savings & reduced water treatment costs
<b>Konjic, Bosnia-Herzegovina</b>	Water Loss Reduction for Konjic Municipal Water Utility <sup>21</sup>	Water loss & water resource management, including new tariffs & GIS-based customer information system, on a 40-yr. old distribution network with UFW of 60–70 %	Water conservation, financial viability of utility; delay of capex for rehabilitation; introduction of commercial practices & price reform	Reduction of 2 million m <sup>3</sup> of losses over 5 years. Increased revenues of \$600,000 from price reform.
<b>Krasnogorsk, Russia</b>	Water Utility Reform and Water Efficiency <sup>22</sup>	Upgrading and automation of the entire water supply network, including variable speed drives, pressure sensors, and control of pumps and storage according to water demand	Transforming municipal enterprises into viable commercial entities;	Savings kWh/m <sup>3</sup> 0.19 Total Use 15 (MWh) 17% 0.1%
<b>Veracruz, Mexico</b>	Energy efficiency plan for the Metropolitan System of Water and Sanitation <sup>23</sup>	Energy/hydrology diagnostics + sectorization & GIS maps + well rehabilitation, VSDs, and SCADA	Service interruptions, high operating costs and customer complaints	24% Energy savings, pumping energy intensity reduced from .48 to .39 kWh/m <sup>3</sup>
<b>Soweto, South Africa</b>	Operation Gcin amanzi (Save Water) <sup>24</sup>	Individual prepayment meters, rehabilitation of the delivery network + private plumbing fixtures, tariff reform, community empowerment	<ul style="list-style-type: none"> <li>• UFW of 200%</li> <li>• Unreliable supplies</li> <li>• Dilapidated facilities</li> </ul>	Monthly HH water needs dropped by 85%, saving 15 million kL water 27 million kWh of power, and \$7 million
<b>Fortalez, Brazil</b>	Study and implement energy and water savings measures in the water company (CAGECE) <sup>25</sup>	Water system automation, improved efficiency of pumps, optimized storage and delivery arrangements	High operating costs & Susceptibility to power cuts	<ul style="list-style-type: none"> <li>• 22 GWh energy savings</li> <li>• \$2.5 million annual savings</li> <li>• Improved reliability</li> </ul>

<sup>20</sup> Ecolinks, [www.rec.org/ecolinks/bestpractices/PDF/romania\\_aquaserv.pdf](http://www.rec.org/ecolinks/bestpractices/PDF/romania_aquaserv.pdf)<sup>21</sup> Ecolinks, [www.rec.org/ecolinks/bestpractices/PDF/bih-VIK.pdf](http://www.rec.org/ecolinks/bestpractices/PDF/bih-VIK.pdf)<sup>22</sup> MUNEE, [www.munee.org/go.idecs?i=51](http://www.munee.org/go.idecs?i=51)<sup>23</sup> Alliance to Save Energy Watery Case Study, [www.watery.net/resources/casestudies/veracruz\\_mexico.pdf](http://www.watery.net/resources/casestudies/veracruz_mexico.pdf)<sup>24</sup> Alliance to Save Energy Watery Case Study, [www.watery.net/resources/casestudies/soweto\\_southafrica.pdf](http://www.watery.net/resources/casestudies/soweto_southafrica.pdf)<sup>25</sup> Alliance to Save Energy Watery Case Study, [www.watery.net/resources/casestudies/fortaleza\\_brazil.pdf](http://www.watery.net/resources/casestudies/fortaleza_brazil.pdf)

coordination yielded a 25% improvement in the energy intensity of delivered water. In the City of Fortaleza, Brazil, application of modeling and control technology allowed optimization of the integrated water supply and distribution network, resulting in significant electricity savings.

### **Solid waste management**

As shown in Table 16, good practice examples in the solid waste management area come from a variety of sources, notably the International Council for Local Environmental Initiatives (ICLEI), and can be found in all regions. In Kromeriz, Czech Republic, Naga, Philippines, and Sao Paulo, Brazil, uncontrolled legacy landfills were rehabilitated to stop the environmental impacts of leachate and to allow capture and productive use of landfill gas. Projects in Khabarovsk, Russia and Danube Region, Bulgaria illustrate innovative approaches to recycling, waste stream volume reduction, and local/regional coordination to provide solid waste management services. In most of the examples, the local development benefits of landfill rehabilitation and improvement are multiple, including environmental improvement, jobs creation, operational cost reduction, and improved

profitability through carbon revenue streams. The examples also suggest incremental climate change mitigation opportunities beyond landfill gas, including materials recovery, recycling and composting.

### **General infrastructure and buildings**

Good practice examples in general urban infrastructure can be found as well. As shown in Table 17, Sofia, Bulgaria, Mexico City, Mexico, and Cape Town, South Africa have all given comprehensive city-wide attention to climate change mitigation opportunities in urban infrastructure and invested in multi-year investment programs to systematically capture GHG emissions reduction opportunities. As a result, each of these cities has seen an impressive reduction in its city-wide carbon footprint. The European Distributed Energy Partnership (EU DEEP) is comprehensive in that it addresses the sustainability of all aspects of municipal infrastructure, including building materials, facility operations, and even the ongoing procurement of goods and services for municipal use. These examples point to the benefits of increased capacity within cities and municipalities to comprehensively address the sustainability of municipal infrastructure and operations.

Table 16: Good Practice Examples of Climate Change Mitigation in Solid Waste Management Projects

City/Country	Project Title	Project Description	Key Drivers	Metrics & Indicators
Khabarovsk, Russia	Community Waste Recycling Program <sup>26</sup>	Sustainable neighborhood recycling reduced the volume of organics flowing to the landfill and creating secondary materials for local manufacture	Conserving landfill space, Creating local jobs	Recycling paper & textiles saved 65,000 kWh of energy in making roofing paper
Danube Region, Bulgaria	Modernization of SWM in Bulgaria <sup>27</sup>	Regional study of SWM to identify improved practices (composting, waste stream separation, improved collection, measurement & tolling), investments (vehicles, containers, regionalized landfills), and business models (public-private partnerships, village-level micro-enterprise, regional coops)	Urbanization-created stresses on proper disposal of SWM, groundwater & runoff pollution, need for regional solutions; financial burden on municipalities	Operational savings from regionalization, waste minimization due to local composting, leachate prevention, improved utilization of scarce landfills
Kromeriz, Czech Republic	Biogas from Household Waste <sup>28</sup>	Rehabilitation of legacy dumpsites to eliminate leachate, capture methane, and create local open spaces	Environmental impacts of uncontrolled landfills; control of energy costs; urbanization	Some 337,177 m <sup>3</sup> of biogas has been captured and used as HH heating fuel
Naga, The Philippines <sup>29</sup>	Making Fertilizer from Waste	The city of Naga has built a Materials Recovery Facility (MRF) in an area that was once a dumpsite and is now a controlled landfill. The MRF enables the city to effectively reuse, recycle, and compost the 60 tons of municipal waste generated in the city every day.	Environmental hazards of uncontrolled landfills, conserving scarce land, reducing the cost of urban services	16,000 tpy of reduced greenhouse gas emissions USD \$168,000 a year operational savings
Sao Paulo, Brazil <sup>30</sup>	Converting Waste to Energy for Local Power Generation	São Paulo rehabilitated the Bandeirantes Landfill dump to allow landfill gas capture and use in a 20 MW power plant serving the area. The landfill receives an average 7,000 tons of waste a day from the city of São Paulo.	High cost of urban services, financially sustainable SWM practices, power shortages, local self-reliance	730,000 tpy of GHG emission reductions as well as power output and revenue from carbon credits

<sup>26</sup> Ecolink, [www.rec.org/ecolinks/bestpractices/PDF/russia\\_megan.pdf](http://www.rec.org/ecolinks/bestpractices/PDF/russia_megan.pdf)

<sup>27</sup> Ecolinks, [www.rec.org/ecolinks/bestpractices/PDF/bulgaria\\_modernization.pdf](http://www.rec.org/ecolinks/bestpractices/PDF/bulgaria_modernization.pdf)

<sup>28</sup> UN-Habitat, [www.bestpractices.org/bpbriets/urban\\_infrastructure.html](http://www.bestpractices.org/bpbriets/urban_infrastructure.html)

<sup>29</sup> ICLEI. 2006. International Progress Report on "Cities for Climate Protection". Available at:

[http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP\\_International\\_Report-2006.pdf](http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP_International_Report-2006.pdf). Last accessed on March 25, 2007.

<sup>30</sup> ICLEI. 2006. International Progress Report on "Cities for Climate Protection". Available at:

[http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP\\_International\\_Report-2006.pdf](http://www.iclei.org/documents/USA/documents/CCP/ICLEI-CCP_International_Report-2006.pdf). Last accessed on March 25, 2007.

Table 17: Good Practice Examples of Climate Change Mitigation in the Power, Energy and General Urban Infrastructure Areas

Country	Project Title	Project Description	Key Drivers	Metrics and Indicators
Sofia, Bulgaria	City-Wide Energy Efficiency Action Plan <sup>31</sup>	The City of Sofia undertook complete review of energy consumption, identifying energy conservation measures, and preparing a long-term plan including financing and solutions to legal and administrative barriers	Excessive energy use in public buildings caused high operating costs & poor quality of services delivered	Public buildings energy consumption reduced by 30% in 314 municipal buildings and 300,000 residential units
Bishkek, Kyrgyzstan	Energy Efficiency at the Republican Center of Surgery <sup>32</sup>	Improvements in district heating systems, including pipe insulation, flow regulators, room temperature reductions based on occupancy, and regular O&M	Poor indoor climate quality in winter; high heating bills	Total cost: \$32,000 Bill savings: \$17,000 per yr
Mexico City, Mexico	Energy Efficiency in Social Housing <sup>33</sup>	Comprehensive study of opportunities for energy and water savings in social housing yielded a plan to install compact fluorescent bulbs, low-flow showerheads, and tap aerators into 75,000 social housing units over three years.	Financially sustainable public housing	The estimated emissions reduction from these changes is 31,000 tons CO <sub>2</sub> per year.
Cape Town, South Africa	Sustainable Local Governments Program	Cape Town is addressing GHG emissions across sectors, including retrofitting of municipal buildings for energy efficiency, retrofitting 2,310 households in Khayelitsha, promoting high density public transport corridors and bus rapid transit systems, and rehabilitating the Bellville South landfill site to capture methane emissions to be used as an energy source for adjacent industry.	Power crunch, desirability to be a world-class African city, upcoming World Cup and Olympics	5% reduction in electricity use, 10% reduction in CO <sub>2</sub> emission, 10% reduction in private vehicle trips, and 90% penetration of CFL lighting – all by 2010
EU	Dissemination of Energy Efficiency Measures in Public Buildings (DEEP) <sup>34</sup>	DEEP assists European public authorities to shift to more sustainable building design and use of “green” electricity. Simple standards applicable Europe-wide are developed for energy performance, procurement of goods, use of sustainable building materials for public construction and renovation works, together with purchasing criteria for green electricity.	Reducing energy needs of public buildings and operations, increasing the sustainability of urban infrastructure, meeting GHG emissions reduction targets	Reduce GHG emissions by 40% over today’s levels

<sup>31</sup> Ecolinks, [www.rec.org/ecolinks/bestpractices/PDF/bulgaria\\_energy.pdf](http://www.rec.org/ecolinks/bestpractices/PDF/bulgaria_energy.pdf)

<sup>32</sup> Energy Savings International AS, [www.ensi.no/references/040909.sf.td.Brochure%20Children%20Hospital.pdf](http://www.ensi.no/references/040909.sf.td.Brochure%20Children%20Hospital.pdf)

<sup>33</sup> The Climate Group, Case Studies. Available at: [http://thelimategroup.org/index.php/reducing\\_emissions/case\\_studies/](http://thelimategroup.org/index.php/reducing_emissions/case_studies/). Last accessed on March 25, 2007.

<sup>34</sup> <http://www.iclei-europe.org/deep>

## 5 CONSULTATIONS WITH URBAN PRACTITIONERS

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After the review was completed, one-on-one meetings were conducted with urban practitioners from all six regions. These practitioners were provided with the portfolio review results, as well as initial ideas regarding incremental climate change mitigation opportunities for each type of infrastructure. The consultations were structured around a simple template of discussion topics, which have also been used to organize this section.

### **Desirability of mainstreaming climate change mitigation in urban infrastructure projects**

Practitioners noted that Bank assistance to the sector comprises just a diminutive amount of total urban investment. Therefore, any impact the Bank could have on the urban climate change mitigation agenda would have to be highly leveraged, either by mobilizing additional lending or by demonstrating good practice and overall leadership.

Some regions appeared to have made more progress than others in terms of raising

climate change-related issues (mitigation and adaptation) within urban policy dialogue and sector work. A brief concept note on cities and climate change in the Bank's Middle East and North Africa Region (MNA) emphasizes the need for governments to plan for both adaptation and mitigation measures to reduce GHG emissions, which would reduce oil imports and provide carbon emissions trading opportunities.<sup>35</sup> Specific mitigation measures suited to MNA cities include energy efficiency in private buildings and municipal facilities, production of electricity from renewable energy sources, methane recuperation from solid-waste management facilities, and co-benefits from efforts to improve urban mobility and reduce traffic congestion. In countries in the Bank's Latin America and Caribbean Region (LAC), urban practitioners have started circulating a newsletter entitled *Carbon Copy - Carbon Finance in Latin America and Caribbean Cities* [8].

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<sup>35</sup> *MNA Cities and Climate Change*, Anthony G. Bigio, Sr. Urban Specialist, MNSSD, April 19 2007.

Practitioners agreed that mainstreaming climate change mitigation opportunities was most complete in the solid waste management, energy, and power sectors, followed by urban transport. The water supply, sanitation and general urban infrastructure sectors were seen as somewhat lagging, at least in relative terms.<sup>36</sup>

### **Climate change mitigation-urban infrastructure linkages**

Mainstreaming climate change mitigation requires finding the areas of overlap between the development agenda and macro-economic objectives and climate change mitigation.

All respondents underscored the necessity of aligning incremental climate change mitigation opportunities with existing factors driving urban policy and investment. Typical drivers include: high and increasing cost of oil to oil-importing countries, energy efficiency as an energy security concern; local air pollution abatement and urban congestion solutions, which can also bring global benefits; new sources of financing from climate change sources such as the GEF and the Kyoto Protocol-based Clean Development Mechanism (CDM); access to a minimum level of urban services such as water supply and sanitation, waste collection, affordable transport, or health and

<sup>36</sup> In this report we have grouped together results from the General Urban Infrastructure and Energy and Power sectors into one large General Urban Infrastructure category.

education services delivered via urban infrastructure; and financial sustainability of municipal entities and state-owned utilities that provide urban services.

Respondents also pointed to the need to effectively incorporate climate change mitigation components within lending operations, in order to identify the real incentives that developing countries have to pursue climate change mitigation and to show how global benefits of climate change mitigation yield local benefits or vice versa.

Several respondents noted that the reason that carbon finance and carbon offset projects have made recent strides is because they clearly support key country and sector objectives by defraying the cost of delivering urban services or improving management of scarce resources.

Practitioners noted that municipal officials are inherently conservative. They will only consider capturing climate change mitigation opportunities if they make comparable or better contributions to sector and project development objectives than other alternative uses of the funds.

### **Including climate change mitigation in the urban assistance portfolio**

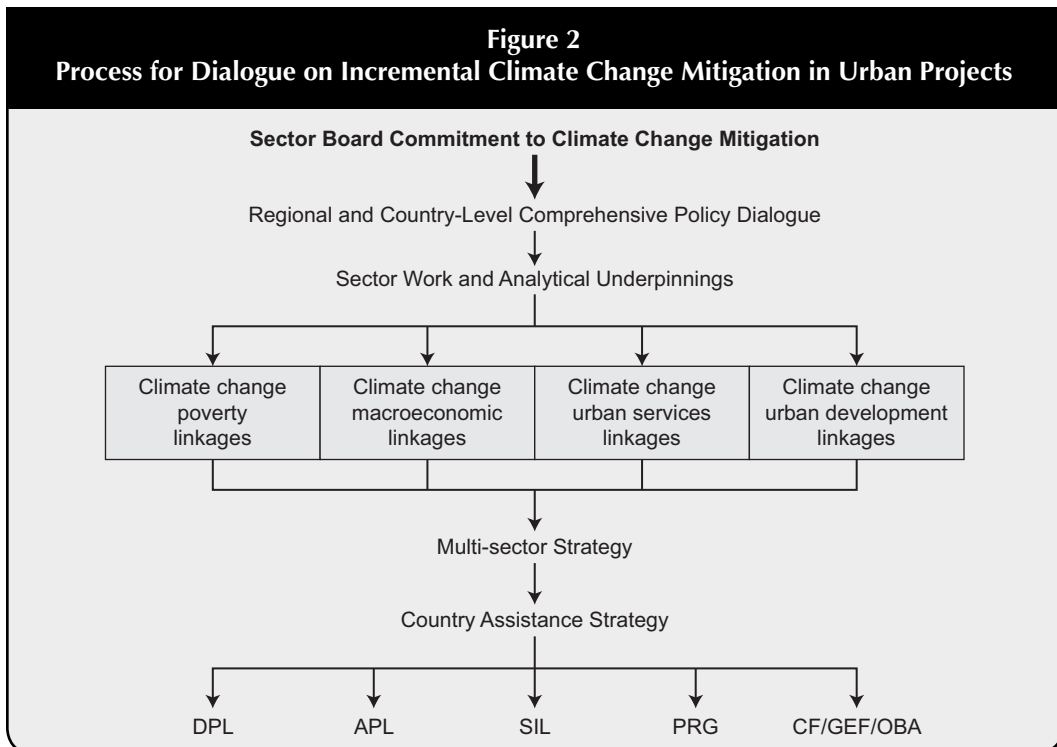
Respondents suggested a simultaneous bottom-up and top-down effort to engage urban sector practitioners and managers. Respondents stressed the importance of engagement at the Sector Board and at the

regional Sector Manager level. Several recommended that the environment department formally brief the Bank’s Urban Sector Board, describing why climate change mitigation is important in the urban context, and providing specific proposals for additional resources and operational guidelines. Sector Board support and participation by the urban center are essential if climate change mitigation is to become part of the urban policy dialogue and taken into account in project preparation.

In some regions the advent of results-focused Country Assistance Strategies may provide new opportunities to include climate change mitigation. There were different opinions regarding the importance of

embracing climate change mitigation within country policy and strategy documents such as the CAS and country policy reports such as the PRSP. Although all agreed such inclusions were useful, as it presupposes a dialogue on climate change issues with PREM and Country Directors, it is not sufficient to guarantee consideration of climate change in the preparation of individual projects.

Figure 2 depicts the sequence of engagement suggested by practitioners. The first step is to work with the Urban Sector Board to create new commitments to pursue additional climate change mitigation opportunities. Equally important is engaging with regional unit managers and country leads for each urban sector. These engagements



could be significantly aided by analytic work, examples of regionally-based good practices, and availability of additional resources. The critical step is to develop concrete arguments to convince practitioners of the relevance of climate change mitigation to existing and future sector objectives and development outcomes. The results of this dialogue can then find their way into policy documents such as the CAS.

There is also a need for counterparts to embrace the concept of climate change inclusion as a priority for assistance, and to be willing to borrow for it. If inclusion of additional climate change increases the size of the loan, then it will be competing at the margin with country-driven development priorities.

Several respondents pointed out the potential supportive role that the environment units within each region might play in encouraging greater inclusion of climate change mitigation opportunities. Although no respondent suggested formal inclusion of climate change mitigation within the integrated safeguards assessment process, environment unit staff reviewing project concepts and participating in project preparation and appraisal are usually capable in highlighting incremental opportunities for climate change mitigation. However, their ability to do so would be improved if they were provided with templates of good practice examples selected to match the regional context.

Several practitioners pointed out the importance of engaging directly with political leaders in the urban context, e.g., mayors, as an entry point. These political leaders are also opinion leaders, and are much more likely to be open to the potential for aligning global climate change mitigation opportunities with local urban development objectives. Moreover, these urban leaders are often connected into a wider network of opinion leaders. One outstanding example of collaboration between urban leaders is the C40 group of big cities who are collaboratively developing methodologies for estimating total GHG emission on an urban-wide scale and undertaking comprehensive mitigation efforts with specific target on a long-term basis.<sup>37</sup>

### **Practical issues and barriers**

The main barriers to greater inclusion of climate change mitigation opportunities are:

- lack of expertise and available resources within the sustainable development network;
- difficulties in getting the attention of task team leaders, sector managers, and counterparts; and
- lack of awareness and understanding by urban practitioners and counterparts of the potential benefits of climate change mitigation in the urban setting.

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<sup>37</sup> See *Low Carbon Leader: Cities*. The Climate Group, Oct. 2005. [http://www.theclimategroup.org/assets/Cities\\_publication.pdf](http://www.theclimategroup.org/assets/Cities_publication.pdf)

Even though the above constraints may be fast disappearing because of the growing interest in climate change, several practitioners noted that the incremental cost in terms of additional sector work, more project preparation, and larger lending and assistance requirements could still be seen as a barrier by both Bank staff and counterparts. Practitioners would be open to considering incremental climate change mitigation opportunities but only if it did not detract from their other priorities or require extra resources or incur extra costs.

### **Analytic work required to scale-up climate change mitigation**

Several practitioners identified specific infrastructure additions or mitigations that deserve further analysis in order to fully understand their climate change mitigation value. Examples include long sea outfalls for sewage disposal, upgrading tertiary road surfaces to improve fuel economy, large-scale recycling, composting, and methane gas from sewage treatment and sludge disposal. Analytic work is vital not only to understanding the dynamics of a climate change mitigation intervention, but also to develop the Measurement and Verification (M&V) methodologies needed to develop an incremental cost analysis or to qualify the mitigation measure for carbon financing.

Several practitioners suggested development of handbook or tool kits that describe indicative climate change mitigation measures

and their impacts, both in terms of GHG emissions reductions and contributions to sector and development objectives. In this regard much of the work done by the urban infrastructure-focused networks described in Section 5, such as MUNEE, ICLEI, and Watergy, are worthy of note.

Each region has specific urban infrastructure priorities and development needs. There is a need for analytic work to identify the potential climate change mitigation modalities for an array of different urban sector priorities and development needs. For example, in MNA, key urban sector priorities include municipal finance, decentralization, land issues, housing and slum upgrades, and cultural heritage. Climate change mitigation measures well suited to apply to these sector priorities need to be developed and demonstrated.

Similarly, the identification and dissemination of good practice in urban-centered climate change mitigation measures is essential. Furthermore, the good practice examples must embrace and demonstrate mainstreaming within each region's context and priorities.

Benchmarking can play an important role in raising awareness of opportunities and "good practice gaps" between regions and countries. Although there are many daunting issues in comparing between cities in all their diversity, one exciting development is

the Global City Indicators Project, which the World Bank is supporting through the World Bank Institute. Included among the array of indicators nominated for data collection and reporting will be environmental sustainability, as measured by greenhouse gas emission per capita [9].

### **Gaining entry to project preparation**

Probably the single most important practical consideration to moving the urban climate change mitigation agenda forward is how to gain entry to the project preparation process. Incorporating climate change mitigation opportunities within high-level policy dialogues and within guidance documents such as the CAS and PRSP is important; however, gaining entry to the preparation process of specific urban infrastructure projects is the only way that the value of additional climate change mitigation can be proven. The respondents had several suggestions on how to initiate this dialogue:

- build on the requirement to consider environmental issues contained in the PCN template;
- undertake “component preparation pilots,” where climate change mitigation specialists would work with urban practitioners in identifying incremental climate change mitigation opportunities for inclusion in projects under preparation; and
- consider climate change opportunities as part of the feasibility studies typically undertaken ahead of project appraisal.

Several respondents suggested that the regional environment unit is well placed to pursue entry points on an ongoing basis. However, this would likely require some capacity building and technical training of regional environmental staff. No-one suggested formal incorporation of climate change mitigation into the existing integrated safeguards process.

Any of these entry strategies would benefit from the availability of a cadre of climate change mitigation experts in the Environment or Urban center who could be mobilized to assist in project preparation, sector work, or policy dialogue within the Bank and with counterparts. These experts would be made available to assist in project reconnaissance and preparation, participate in project pre-appraisal and appraisal, and to engage with counterparts on the value of climate change mitigation activities.

### **Support needs**

Respondents pointed out that awareness of climate change issues was high in the developing countries in which they work. The challenge was in developing a strategy to engage in climate change mitigation that did not detract from the myriad other priorities for development assistance. In this regard additional assistance to both Bank staff and counterparts in pursuing a climate change mitigation dialogue in the country context and providing specific financial and technical assistance would be beneficial. Such assistance might be centered in a trust

fund facility similar to ESMAP or ASTAE at the regional or global level.

Respondents also suggested that training sessions on climate change mitigation opportunities and financing might be beneficial. Any such outreach or training to Bank staff would have to be regionally and sector-focused, short, and action oriented.

Another way to increase awareness of climate change mitigation opportunities in the urban context would be brief (4 pages) guidance or applications notes which include quantitative results and are chosen to resonate with specific regions or types of infrastructure. A good practice example of this type of knowledge dissemination is the carbon finance newsletter produced by LAC [8].

Another suggestion for sharing good practice would be to organize BBL sessions under the infrastructure sector boards that highlight the climate change mitigation opportunities within specific projects, including results where available.

### **Financing strategies for climate change mitigation**

Practitioners noted the lack of projects which blend together different financing sources. For example, while there are

many stand-alone GEF and carbon finance projects, there are relatively few projects that include IDA- or IBRD-financed components together with GEF and carbon-financed components. This would seem to be a missed opportunity, since blending IBRD lending with carbon finance could partially offset the higher IBRD interest payments.

The urban context presents important opportunities for programmatic lending, either through APLs or adjustment operations (PSAL/Cs). Such programmatic lending is distinct from an SIL and more similar to sector-wide approaches (SWAp), where the Bank is financing a certain category of investments (transport, water supply, etc.) over a certain period of time. This approach lends itself to incorporating climate change mitigation (or adaptation), as the programmatic lending outcomes are expressed on a city-wide basis using measurable indicators (e.g., commuting trip length, GHG emissions per capita). It is likely that in some regions (LAC, EAP) programmatic lending under IBRD will increase, with the possibility that programmatic climate change financing mechanisms could be added to support incremental climate change mitigation opportunities.



## 6 CONCLUSIONS

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The study comprised three parts, each of which is reported in separate sections of this report: (i) a review of the Bank's historical urban portfolio (1995–2005) focused on documenting opportunities for climate change mitigation; (ii) a review of good practice outside the Bank for climate change mitigation targeted to urban infrastructure; and (iii) consultations with urban sector practitioners regarding practical aspects of incorporating climate change mitigation components within urban infrastructure projects.

### Conclusions of the portfolio review

The study suggests that there are already some best practice projects in the Bank portfolio but significant untapped climate change mitigation opportunities also exist. The greatest unrealized potential was found in two sub-sectors – Water Supply and Sanitation (WSS) and General Urban Infrastructure, including Buildings. However, Urban Transport may well have the largest absolute

climate change mitigation potential simply due to the scale of urban vehicular emissions to climate change. Table 1 summarizes both the conventional components found in each category of urban infrastructure project as well as the additional climate change mitigation opportunities.

The portfolio review also looked for and found entry points and linkages to sector and development objectives that would mainstream the inclusion of climate change mitigation opportunities. **An entry point or linkage exists whenever the climate change mitigation opportunity can be clearly shown to generate co-benefits in terms of contribution to the broader sector and project development objectives of the client country.** Examples of linkages to development objectives or macroeconomic pillars included:

- When energy efficiency or water loss reduction measures reduces the delivery

costs of essential urban services, making them more affordable and more accessible to the urban poor;

- When local recycling or solid waste stream separation generates local income and jobs;
- When additional arrangements for non-motorized transport (bicycle or pedestrian) reduces congestion and air pollution from short-duration trips;
- When improved thermal performance of buildings reduces the fiscal drain of heating and cooling public buildings and creates an indoor environment where essential health and education services can be more effectively delivered.
- When capacity for city planning is expanded sufficiently to impact the long-term urban patterns in the direction of mixed-use development or more compact urban and peri-urban footprints, thus reducing the demand for transportation services, primary energy, and other GHG emission-producing resources.

### **Climate change mitigation vs. adaptation**

The focus of this study was on climate change mitigation opportunities in the World Bank's urban portfolio. However, of increasing interest for future project design is the overlap between adaptation measures and mitigation measures in the urban context. For example, improving the energy efficiency of building construction (with improved insulation, reflective glass, or efficient air conditioning) will mitigate

climate change by reducing GHG emissions while also rendering the urban infrastructure more adaptable to hotter weather conditions. Similarly, several projects focusing on urban water supply were found to have unrealized adaptation value, especially as regards securing diversity and sustainability in water sources.

The adaptation agenda is not nearly as well-developed as the mitigation agenda, but will be equally or more important in future urban projects. For example, climate change-induced increases in asthma, malaria, dengue fever, and possibly rat-vector borne ailments will place new demands on urban public health infrastructure. Similarly, there are strong linkages between comprehensive disaster preparedness and climate change, especially as regards building resilience into urban infrastructure.

This study concludes that climate change adaptation should be given an equal footing in developing linkages between climate change and assistance to urban infrastructure. A next step suggested in this regard is a study focused on the climate change adaptation potential, including a review of good practice inside and outside the Bank.

### **Good practice outside the Bank**

There is a growing volume of urban climate change mitigation good practice outside of the Bank, including valuable knowledge networks and associations focused on the

urban context. The Bank should take advantage of this growing knowledge base and project experience by scaling-up its collaboration with groups, NGOs and donors such as EMBARQ, MUNEE, ICLEI, The Climate Group, the Alliance to Save Energy, USAID, SIDA, and UNECE.

### **Barriers to additional climate change mitigation**

Realizing additional climate change mitigation within urban infrastructure lending and assistance will require overcoming a succession of barriers:

- *Relevance.* The climate change mitigation agenda must align with the broader development agenda and support macroeconomic objectives, e.g., defraying the cost of delivering urban services or improving management of scarce resources. Mainstreaming climate change mitigation requires finding the areas of overlap between development objectives and climate change mitigation.
- *Convincing the Counterparts.* Counterparts must embrace the climate change mitigation as a priority for assistance, and be willing to borrow for it. If inclusion of additional climate change increases the size of the loan then it will be competing at the margin with country-driven development priorities. This underscores the importance of focusing on incremental climate change mitigation opportunities that contribute to mainstream development objectives and macroeconomic concerns. One possible path might be engaging directly with political leaders in the urban context, e.g., mayors, as an entry point. These political leaders are also opinion leaders, and are much more likely to be open to the potential for aligning global climate change mitigation opportunities with local urban development objectives.
- *Operational Barriers.* The main barriers to greater inclusion of climate change mitigation opportunities are (i) the lack of expertise and resources available within the sustainable development network; (ii) difficulties in getting the attention of task team leaders, sector managers, and counterparts; (iii) lack of awareness and understanding by urban practitioners and counterparts of the potential benefits of climate change mitigation in the urban setting; and (iv) competing priorities and limited preparation time. Overcoming these barriers will require resources and expertise; thus, a climate change mitigation “SWOT team” has been suggested,<sup>38</sup> that can provide support to regions by doing quick diagnostic exercises. Practitioners would be open to considering incremental climate change mitigation opportunities but only if it did increase their work load, preparation budget or preparation time.

<sup>38</sup> A similar proposal is contained in the proposal to scale-up energy efficiency investment within the Bank.

### Next steps

A clear view of next steps emerged from the portfolio review process and consultations with urban practitioners. Practitioners stressed the importance of engagement at the Sector Board level and at the regional Sector Manager level as an essential first step. Practitioners also recommended that the Environment Anchor formally engage the Urban Sector board, describing the rationale for incorporating additional climate change mitigation within the urban context and suggesting new initiatives (e.g., additional resources and operational guidelines) to make it happen. The report was also disseminated within the Bank. The team also received valuable comments from participants at a presentation of this work to delegates from the Bangkok Metropolitan Administration in May 2007, as well as at the Cities and Climate Change Workshop in June 2007, and to the Energy Efficiency Thematic Group in October 2007.

Engagement at the Sector Board, Unit Director, and practitioner level must be followed by designating resources necessary to identify entry points for mainstreaming climate change mitigation in the regional and country-specific urban context. Finding workable climate change mitigation opportunities that deliver local as well as global benefits will require accelerated knowledge management efforts (e.g., a handbook on indicative climate change mitigation measures and their local and global benefits); sector work (to match climate change mitigation modalities with

urban sector priorities such as municipal finance, decentralization, land issues, housing and slum upgrades, cultural heritage, etc.); piloting efforts to demonstrate climate change-urban infrastructure linkages in specific projects; and analytic development (to create benchmarks/indicators that cities can use to identify opportunities and identify “good practice gaps” in urban infrastructure).

Specific follow-on activities suggested by urban practitioners and peer reviewers include:

- Preparation of guidance notes focused on capturing additional climate change mitigation opportunities in relatively under-served urban sub-sectors, notably water supply and sanitation and general infrastructure including buildings;
- Undertake a similar portfolio review focused on climate change adaptation opportunities in the urban context;
- Collaborate with interested urban practitioners to pilot the key findings and guidelines in an operational setting;
- Undertake analytic work needed to create climate change-related performance indicators that are relevant to city managers and allow for monitoring the effect of climate change mitigation measures over time; and
- Undertake analytical work in order to develop a co-benefits framework, which helps link climate change mitigation interventions to local benefits/priorities.

# 7

## REFERENCES

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**Annex 1: Listing of Urban Projects Reviewed**

<b>Sector</b>	<b>Region</b>	<b>Country</b>	<b>Project</b>	<b>Fiscal Year</b>	<b>Project ID</b>
Urban Transport	AFR	Senegal	Urban Mobility Improvement	FY00	55472
	EAP	China	Guangzhou City Transport	FY98	3614
	EAP	Philippines	Metro Manila Urban Transport Improvement	FY01	57731
	LAC	Argentina	Buenos Aires Urban Transport	FY97	39584
	LAC	Brazil	Sao Paulo Metro Line 4	FY02	51696
	LAC	Colombia	Bogota Urban Transport	FY96	6872
Water Supply & Sewerage	AFR	Burkina Faso	Ouagadougou Water Supply	FY01	306
	EAP	Cambodia	Urban Water Supply	FY98	45629
	EAP	China	Second Shanghai Sewerage	FY96	3648
	EAP	Mongolia	Second Ulaanbaatar Services Improvement	FY04	74591
	EAP	Vietnam	Water Supply	FY97	4830
	ECA	Azerbaijan	Greater Baku Water Supply Rehabilitation	FY95	8288
	ECA	Ukraine	Lviv Water/Wastewater	FY01	35786
	LAC	Uruguay	Water & Sanitation Modernization	FY00	63383
	MNA	Iran	Ahwaz & Shiraz Water and Sanitation	FY04	71191
	SA	India	Bombay Sewage Disposal	FY96	10480
Solid Waste Management	EAP	China	Hubei Urban Environment	FY96	3602
	EAP	China	Second Shanghai Urban APL	FY06	75732
	EAP	Vietnam	Three Cities Sanitation	FY99	51553
	ECA	Latvia	Municipal Solid Waste	FY98	40553
	ECA	Uzbekistan	Tashkent Solid Waste	FY98	49582
	MNA	West Bank and Gaza	Solid Waste & Environmental Management	FY01	54051
	EAP	Indonesia	Kalimantan Urban Development	FY94	3951
	ECA	Georgia	Municipal Infrastructure Rehabilitation	FY95	8417
District Heat & Buildngs)	AFR	Ghana	Urban Environmental Sanitation	FY96	973
	AFR	Rwanda	Urban Infrastructure & City Management APL	FY06	60005
	EAP	China	Zhejiang Urban Environment	FY04	66955

*(Continued on next page)*

**Annex 1: Listing of Urban Projects Reviewed (Continued)**

<b>Sector</b>	<b>Region</b>	<b>Country</b>	<b>Project</b>	<b>Fiscal Year</b>	<b>Project ID</b>
EAP		Indonesia	East Java UDP II	FY96	39312
ECA		Belarus	Social Infrastructure Retrofit	FY01	44748
ECA		Croatia	District Heating Project	FY06	94389
ECA		Kyrgyz Republic	Small Towns Infrastructure & Capacity Building	FY05	83377
ECA		Latvia	Riga District Heating Rehabilitation	FY01	8530
ECA		Lithuania	Municipal Development	FY99	35802
ECA		Ukraine	Kiev Public Buildings Energy Efficiency	FY00	55739
ECA		Ukraine	Sevastopol Heat Supply Improvement	FY01	55738
MNA		Djibouti	Power Access and Diversification	FY06	86379
MNA		Lebanon	First Municipal Infrastructure	FY00	50544
SA		India	Third Tamil Nadu Urban	FY06	83780



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