Growing Infrastructure with a Shrinking Footprint

October 11, 2012

Moderator: Rodolfo Camacho
Abt Associates
Vice President, International Economic Growth Division

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Energy Efficiency Program Design, Marketing & Communications

• **Why You Should Care:**
  - Rising energy demands threaten energy security, economic growth, and the environment
  - Energy efficiency provides a low-cost, diverse, stable, and environmentally sound resource base
  - Consumers often don’t embrace the need to reduce energy use and don’t know how to do it

• **What Are Your Next Steps:**
  - Tailored energy saving programs that benefit the economy, reduce supply uncertainties, and mitigate climate change
  - Marketing that touches consumers, helps transform the marketplace for energy efficient products

• **Cadmus Can Help:**
  - *The Cadmus Group, Inc.:
  - Facilitates collaborative decision-making among multiple agencies and stakeholders
  - Factors in cost-effectiveness, economic stimulus, and reduced greenhouse gas emissions
  - Conducts market research to inform program design and consumer marketing
  - Orchestrates communications campaigns to produce sustained energy efficient choices
  - Evaluates the effectiveness of program and marketing initiatives

• **Contact:**
  - Linda Dethman, Linda.Dethman@cadmusgroup.com, (503) 467-7146
The benchmark standard for professional water services

- Managing water and wastewater services for public authorities and industry
- Designing technological solutions and building and managing the facilities and systems required to deliver these services
- Construction, rehabilitation and maintenance of networks and associated infrastructure

2009 Revenue
$18.1 billion

95,000 employees

Drinking water services to 95 million people
Wastewater services to 68 million people
Facilities managed +5,260 water +3,220
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- MBA in Sustainability
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Rodolfo Camacho, Vice President, Abt Associates’ International Economic Growth Division, oversees a portfolio of projects on climate change, hydrologic modeling, flood control, water quality analysis, fate and transport of pollutants, trans-boundary water and ecosystem management, pollution control strategies and air quality. He has extensive international experience in water resources management, climate change and public health impacts.
Session Agenda

• Introduction to the Panel: Rodolfo Camacho
• Panel Presentations
  ➢ Eugenie Birch, Penn Institute for Urban Research: energy infrastructure
  ➢ Georges Darido, World Bank: transportation infrastructure as an anchor
  ➢ Joe Lombardo, ICMA International: housing infrastructure challenges
  ➢ Gerald Stedge, Abt Associates: water infrastructure and adaptation
• Panel Discussion Questions
• Audience Questions: Send your questions through the chat box
• Summary Points
• Thank you!
  • Please fill out the audience survey
Dr. Eugenie Birch, Co-Director of the Penn Institute for Urban Research and Chair of Urban Research and Education at UPenn, will discuss energy infrastructure and trends in sustainable urban planning.

Georges Darido, World Bank Senior Transportation Specialist in Latin America and the Caribbean, will discuss transportation policy objectives for reduced carbon footprints and resilience to climate impacts and challenges, and provide examples of success.

Joe Lombardo, Director of ICMA’s Global CityLinks Program, leads the USAID funded city-to-city partnership program designed to help cities in developing countries confront the challenges of rapid urbanization. He has extensive experience with developing and managing USAID programs in housing and urban development.

Dr. Jerry Stedge is a Principal Associate at Abt Associates and leads their Natural Resource practice, consulting for federal government including the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. Dr. Stedge's personal work has focused on water resource issues, specifically the provision of safe drinking water and water resource planning.
Growing Urban Infrastructure with a Shrinking Footprint
Key issues and considerations

Rodolfo Camacho, PhD
October, 2012
Urban Infrastructure Challenges

- Rapid urbanization stresses resources and government’s ability to deliver services
- Urban infrastructure exposed to more frequent and severe natural hazards (rainfall, wind, heat waves)
- Infrastructure lagging behind and aging in rapidly growing cities
- Extensive use of resources and environmental impacts from rapid urbanization (water supply, air and water quality, flooding, land use changes)
- Increased carbon footprint from energy consumption, waste generation, transportation, construction etc.
- Financing
Adaptive Solutions

- Incorporate low-emission climate-resilience development
- Integrate informal settlements and migrate population into city development plans
- Advance research on new infrastructure standards for more frequent severe natural hazards
- Implement policy actions
- Incorporate innovative financing solutions
Growing Urban Infrastructure with a Shrinking Footprint
Security and Sustainability Forum

October 11, 2012

Eugenie L. Birch
Nussdorf Professor of Urban Research
Department of City and Regional Planning
School of Design
Co-Director, Penn Institute for Urban Research
University of Pennsylvania
International trends... World Energy Consumption... US Energy Consumption... Energy and Cities

World Population Growth
10,000 BCE to Present

(population (8.3 billion by 2030))

Population (8.3 billion by 2030) © 2009 Bryan K. Litz

Urban and rural populations by development group. 1950-2050

GDP

Gross domestic product
Personal consumption expenditures
Goods
Durable goods
Refrangible goods
Services
Gross private domestic investment
Fixed investment
Nonresidential structures
Equipment and software
Residential
Change in private inventories
Net exports of goods and services
Exports
Goods
Services
Imports
Goods
Services
Government consumption expenditures and gross investment
Federal
National defense
Nondefense
State and local

Energy Security

Global Warming  Sources and location of CO2 Emissions
World Consumption of oil: 90 million barrels/day
US Share: 21% (19,150 million bbl/day)
World Consumption of coal **18.5 million short tons/day**

**US Share: 17%** (2.6 million short tons/day)
World Consumption of natural gas: 113 Trillion cubic feet
US Share: 50%
Renewables: 16% of world energy
US Share: very small (only 8% of US total energy)
Water used to refine 1 barrel of oil:
1,851 gallons

US: 35 billion gallons daily

Biggest user of water in the US:
Electricity not agriculture
(Half the water withdrawn from rivers, lakes and seashores: 200 million gallons
USGS, 2012)
International trends...World Energy Consumption...US Energy Consumption...Energy and Cities

Demand for Energy

By Use

- Residential, Services, Agric.
- Transport
- Industry

By Energy Type (c.1/3 oil, note electricity)

- Elec
- Gas
- Oil
- Heat
- Coal
- Biom.

International trends... World Energy Consumption... **US Energy Consumption**... Energy and Cities
International trends... World Energy Consumption... **US Energy Consumption**... Energy and Cities
### Environmental and Social Impacts

<table>
<thead>
<tr>
<th><strong>BUILDINGS</strong> (Industrial, Residential, Commercial/Service)</th>
<th><strong>SYSTEMS</strong> (Passenger/Freight Vehicular, Marine, Air, Rail)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Street</td>
</tr>
<tr>
<td>Age</td>
<td>Water/Sewerage</td>
</tr>
<tr>
<td>Types, Design and Form: Density (FAR), Grain, Materials,</td>
<td>Capital Stock (public buildings, bridges, plants)</td>
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<tr>
<td>Window, HVAC</td>
<td></td>
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<tr>
<td>New technologies (e.g. integrated design, adaptive reuse,</td>
<td>Innovations (green infrastructure,</td>
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<td>“hot desks”</td>
<td></td>
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<tr>
<td>Finance and management</td>
<td>Finance and management</td>
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### Economic Effects

**LAND** Economic Effects
International trends...World Energy Consumption...US Energy Consumption...Energy and Cities
Reflections on Sustainable Urban Transport

Georges Darido,
Sr. Transport Specialist
The World Bank, Latin America and Caribbean Region
Increasing demand for mobility, accessibility and rising motorization

Congested infrastructure, slow or costly to expand

Location choice includes trade-offs between property costs, economic opportunities, and transport time+costs

In major Brazilian cities:
- Majority of lower-income people live in periphery
- Urban slum phenomenon: “favela”
- Decentralization of some industries, but job centers remain
Pillars of Sustainable Urban Transport

1. Integrated transport-land use plans, projects and policies
2. Metropolitan governance
3. Financial mechanisms to cover long-run costs
4. Progressive involvement of private sector and civil society
Mini-Case Study: São Paulo, Brazil
Jobs/inhabitant in SP Metro Area
Job-housing imbalance results in excessive peaking
Urban Operations

(for a predefined area) =

• infrastructure investment +
• value capture instrument (CEPAC) +
• urban and social development goals
Luz Rail Station and the “Nova Luz” Urban Operation in the City Center
Metro Line 4
Emerging CBD: Morumbi/Pinheiros River/Agua Espraiada Urban Operation
Transport Demand Management Strategies

Point density plot of single-occupancy automobile trips in Sao Paulo (2007 OD Survey)

Area around Berrini >53% of trips by SOV
A low-carbon, climate resilient approach includes:

– Transport plans that consider financial, environmental, and social trade-offs

– Sound urban transport projects to address mobility and accessibility needs:
  
  • Public transport
  • Non-motorized transport
  • Land use planning
  • Demand management (private vehicles)
  • Strategic roadway and logistic investments

– Coordinated interventions

– Financial instruments
Mitigating Vulnerability of the Urban Poor

Joseph Lombardo
Director, CityLinks Program
Urbanization Trends

- Rural Population
- Total Population

Urban population in 2010 = 3.5 billion
Rural population in 2010 = 3.4 billion

Estimated urban population in 2050 = 6.3 billion
Estimated rural population in 2050 = 2.8 billion

ICMA — Leaders at the Core of Better Communities
Africa Urbanization

- Africa - highest rates of urbanization in the world.

- < 30% of Africa's 1 billion inhabitants currently live in urban areas - by 2030 50%.

- Cairo will grow by 23% to 13.5m people, yet by 2025 both Lagos (15.8m) and Kinshasa (15m) will overtake it.

- FOOD, WATER/SANITATION shortages

- poor INFRASTRUCTURE and LACK OF HOUSING = problems of rapid urbanization.

- SLUM- Dwellers = 70% of urban inhabitants.
Emerging Urban Vulnerability Drivers

- Disasters increasing – 2.6 billion past 10 years vs. 1.6 billion previous decade

- 43.7 million displaced by natural disasters, wars, persecution by end 2010 and 50% live in cities & towns

- Poor are two times more likely to be exposed to natural disasters largely due to their increased concentration in precarious settlements
Ethiopia – Rapid Urban Growth

• Jijiga grew 28% between 2007-2012 (160k today)

• Forced migration due to loss of livelihoods increasing urban population beyond traditional drivers of rural-urban migration (economic & educational opportunity)

• Shelter & infrastructure vulnerability from flooding in gullies, where migrants settle
  • Water systems collapsing, contaminated
  • Power lines fall
  • Drainage threatens housing
Honduras – Hurricane Mitch Reconstruction

- Tens of thousands living in flood plains, hillsides displaced by flooding
- Need for permanent new shelter & resettlement programs in areas away from flood plains
  - Available land
  - Proximity to employment
  - Provision of basic shelter, services (water, sanitation, transport, energy)
- Need for improved urban early warning systems; land use and infrastructure planning
Policy Recommendations to Protect Vulnerable Populations

• Consider not only ex-post disaster response, but also ex-ante disaster exposure of poor

• Improved land use planning to reduce exposure

• Establish early warning systems

• Public infrastructure planning needs to take into account not only future demand, but also resilience to climate change impacts

• Use of market mechanisms to empower poor in relocation decisions – housing vouchers

• Local governments need not only technical capacity, but also political savvy to build consensus for policy prescriptions
Summary Points

• Urbanization is increasingly fueled by forced displacement due to violence, climate change impacts, etc.
• Cities are unprepared to accommodate newcomers in safe, secure environments with proximity to basic shelter, services, employment
• Local governments need technical and political skills to respond and plan
Climate and Severe Weather: Planning for the Water

Jerry Stedge, Ph.D.
Abt Associates Inc.
Overview

- Weather is local -- data on how weather events at the local level may change due to climate change is not available so adaptation planning must be creative.

- Adaptation planning tools can help ensure limited resources are used to achieve greatest risk reduction.

- I will discuss two planning tools – one local and one national in scope.
Water Health and Economic Analysis Tool (WHEAT)

- Developed for U.S. EPA Office of Ground Water and Drinking Water
- Used by water and wastewater utilities to understand the consequences of natural and man-made disasters.
- Estimates the human health, financial, and economic consequences of user defined event.
WHEAT Analysis Includes Seven Process Steps

1. System and Scenario Selection
2. Baseline Inputs
3. Scenario Inputs & Service Loss and Response
4. Public Health Consequences
5. Utility & Regional Economic Consequences
6. Downstream Impacts
7. Summary Reports

User Input Steps

Analysis and Tool Output Steps
WHEAT, cont.

Public Health Impact

Health risks are quantified as injuries and fatalities
Quantified using Acute Exposure Guideline Levels (AEGLs)
• AEGL-1 → Transient health effects
• AEGL-2 → Non-fatal health effects
• AEGL-3 → Fatal health effects

Economic Impact

Utility financial costs
• Change in service revenue
• Change in operating costs
• Capital outlays for asset repair/replacement

Business impacts
• Change in output for directly impacted businesses
• State-level total impacts, due to inter-industry links
• Change in total earnings

Downstream impacts
• Beach visitation, recreational fishing
• DW intakes

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WHEAT and Climate Adaptation

- WHEAT is cause-neutral.
- Utilities can define a range of severe weather events and determine the health, financial, and economic consequences of each.
- User can choose adaptation strategies without knowing the probability of each event using min-max criteria.
- Of course, information on the future probability of future severe weather events would allow for a more probabilistic planning framework.
National Flood Risk Characterization Tool

- Help USACE prioritize flood risk management spending based on risk.
  - Of all potential projects where do we focus our limited budget to do most good?

- Incorporates information on community vulnerability and resiliency into the investment decision.
NFRCT Inputs

- **HAZARD** – FEMA digital flood insurance rating maps (DFIRMS) provide 1% and 0.2% annual flood zones. We used National Elevation Data to estimate distribution of flood depth within each flood zone.

- **EXPOSURE** – People from the census at track level and assets (buildings and vehicles) from FEMA’s HAZUS.

- **VULNERABILITY** and **RESILIENCE** – Social Vulnerability Index (based on socioeconomic indicators) and location of emergency response and hospitals relative to the floodplain.
NFRCT Outputs

- Information on risk components provides a better understanding of what drives flood risk in a location.
- National and State color coded map shows relative values for asset damages, flood inundation, people exposed, and assets exposed.
NFRCT Outputs, cont.

- For each county a report is provided that includes information on:
  - Asset Damages, Inundation, Population Exposure, Asset Exposure, and Vulnerability.
**NFRCT and Climate Adaptation**

- Next generation of NFRCT will display information by watershed (down to HUC-10).
- Climate scenarios will be incorporated by allowing for user-defined changes to the flood zone perimeters on a regional bases (e.g. HUC-2).
- Population change will also be incorporated to simulate future conditions.
Key Points

- Water resource infrastructure decisions made now should consider potential changes in severe weather events.
- The lack of data on the frequency and severity of future storm events means decisions must be made under uncertainty.
- Scenario-based analysis can help to develop alternative futures and adaptation approaches.
Panel Discussion Questions

How do challenges and opportunities differ for large/mega cities and fast-growing intermediate cities?

How can cities share best practices or lessons learned across and between scales?
What policy actions do you recommend to promote low-carbon, climate-resilient development?

to reduce risks from climate variability?
Panel Discussion Questions

What can be done to protect and reduce risk for vulnerable populations of urban poor who tend to be most impacted by extreme weather events?
Audience Questions
Summary Points

Energy
• In light of growing energy demand and constrained resources, urban design is critical to create cyclical processes and optimize energy use.

Transport
• A low-carbon, climate resilient approach should include planning that considers financial, environmental, and social trade-offs.
• Sound urban transport projects need to incorporate strategic roadway and logistic investments, and consider non-motorized transport, land use planning, and private vehicles.
Summary Points

Vulnerable Populations
• Urbanization is increasingly fueled by **forced displacement** due to violence, climate change impacts, etc. and cities are unprepared to accommodate newcomers in safe, secure environments with proximity to basic shelter, services, employment
• Local governments need **technical and political skills** to respond and plan
• Early warning systems and use of market mechanisms to empower poor in relocation decisions should be established

Water Planning Tools
• Resource infrastructure decisions made now should consider **potential changes in severe weather events**
• Scenario-based analysis can help to develop **alternative futures** and adaptation approaches
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