Can We Get There from Here?

Transportation & Climate Adaptation

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Transportation System Resilience, Extreme Weather, and Climate Change Webinar Series

Volpe National Transportation Systems Center

October 8, 2013

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1. Introduction

2. What’s the problem?

3. What solutions do we have?

4. What’s needed for implementation?

5. Continuing progress
Cross-Cutting-Themes

• Greenhouse gas emission reduction
• Public - private collaboration
• National - Local policy coordination
• Maximizing economic and social benefits

CCAP works with policymakers around the world to develop, promote and implement innovative, market-based solutions to major climate, air quality and energy problems.
CCAP: CURRENT EFFORTS

• **MAIN**: Mitigation Action Implementation Network
  – Promote sustainable development in Latin America and Asia

• **US Climate Policy Initiative**

• **Sustainable Urban Transportation**
  – Colombia Transit-Oriented Development NAMA
  – Low-emissions development in Mexico and Saudi Arabia

• **Weathering Climate Risks**
  *Advancing community and corporate resilience*

[www.ccap.org](http://www.ccap.org)
CCAP WEATHERING CLIMATE RISKS PROGRAM

- Resilience planning in Washington DC

- Catalyze implementation progress
  - Stakeholder engagement, Economic and policy analyses

- Inform and inspire replication
  - Pilots, policy recommendations, outreach, webinars, blogs…

- Measuring Climate Resilience
  - People, Infrastructure, Economy (PIE)
  - Implementation progress, effectiveness

- Advancing Mitigation/Adaptation Synergies

CCAP’s Weathering Climate Risks program is made possible through generous support from the Surdna Foundation.
SELECTED PUBLICATIONS: TRANSPORTATION AND ADAPTATION

- Climate Adaptation & Transportation: Identifying Information and Assistance Needs
- Severe Weather & Critical Infrastructure Resilience: Preparing Washington D.C.
- *Growing Wealthier: Smart Growth, Climate Change, & Prosperity*
- The Value of Green Infrastructure for Urban Climate Adaptation
- Lessons Learned on Local Climate Adaptation
- Ask the Climate Question

www.ccap.org
What we build -- where and how -- makes a difference.

**Ask the Climate Question**

- How will infrastructure, land use and policy decisions affect:
  - GHG emissions?
  - Resilience to climate change impacts?

- CCAP’s partners in the Urban Leaders Adaptation Initiative such as King County, Chicago, Toronto, NYC, asked the Climate Question across city departments and functions
CLIMATE POLICY GOALS

• Maximize **GHG Mitigation**,
• **Adapt** to what can’t be mitigated,
• Minimize **Suffering** and
• **Enhance Resilience**.

(based on) John Holdren
Director, White House OSTP

“It’s like breathing and eating” – we must reduce GHGs and adapt!
~ Ron Sims
former King County Executive & HUD Deputy Secretary
“AN INCONVENIENT SEWER OVERFLOW….

… this isn’t about polar bears; it's about backed-up sewers in your streets or basements.”

~ Steve Winkelman in ClimateWire, May 4, 2012
2. THE PROBLEM: A NEW NORMAL?

• Extreme weather events on the rise
  – Storms, floods, heat waves, wild fires…
  – 2011-12: double the average frequency of record extremes in temperature, precipitation, drought, and tropical cyclones (NOAA)

• Major economic losses: Sandy: $65 Billion losses (2012)

• Road repair costs from flooding
  – Colorado: $500 million (2013)
  – North Dakota: $195 million (2011)
  – Ohio: $168 million (2011)
  – Vermont: $200 million (2011, Irene)

• Climate change projected to increase impacts
CLIMATE IMPACT FRAMEWORK: TOO LITTLE / TOO MUCH WATER

- Drought
- Heat waves
- Fire
- Strong storms
- Seal level rise, storm surge
- Riverine flooding

Hazard or Problem Framework

Dry (or too little water)

Wet (too much water)

S. Winkelmann: Can we get there from here? Transportation & Climate Adaptation
What can we do when…

THE LIGHTS GO OUT?

June 2012 Derecho -- after
Source: NASA Earth Observatory
What can we do when…

THE STREETS FLOOD?

Photo source: Keystone USA-ZUMA/Rex Features

S. Winkelman: Can we get there from here? Transportation & Climate Adaptation
What can we do when…

ROADS ARE WASHED OUT?

Chris Schneider AP
What can we do when...

TRAIN STATIONS FLOOD?

PA NY/NJ

S. Winkelman: Can we get there from here? Transportation & Climate Adaptation
What can we do when…

WILDFIRES STRIKE?

Photo source: New York Daily News
EXTREME HEAT BUCKLES RAIL?

FTA
What can we do when…

RUNWAYS SOFTEN?

Phillip Dugaw/Reddit
SECONDARY AND CASCADING EFFECTS ARISE?

• System interactions and interdependencies
  – Power, transport, water, telecom

• Hurricane shuts Galveston Port and Mississippi barge traffic
  – Droughts can do the same

• Storm → branches → river → culvert → road outage

• Multiple storms → soil saturation → sewer overflow, flooding

• Pine beetles + Heat wave → Fires, then storms → erosion

• Derecho → power out → Metro & signal lights out → traffic
3. WHAT SOLUTIONS DO WE HAVE?

A variety of measures:

- Engineering, design, planning, policy
- Short-term and long-term
- Narrowly focused and broad scale
- Directionally-correct and comprehensive
- Cross-cutting and sector specific
LARGE-SCALE, COMMUNITY-WIDE PROTECTION
EXISTING OVERHEAD SYSTEM
“UNDERGROUNDING” POWER LINES

PROPOSED UNDERGROUND PLAN
Problem
NYC subway flooding after a 2007 storm.
Source: MTA NYC Transit

Partial Solution
MTA NYC Transit has allocated nearly $90 million toward raising ventilation grates and installing stair pads at subway entrances.
Source: MTA NYC Transit
EVACUATE IN PLACE

Houston: Hurricane Rita evacuation, 2005
Source: www.houstonfreeways.com

Florida International University – fortified library
Source: Miami-Dade County
GREEN INFRASTRUCTURE

Chicago Climate Action Plan
A 2005 storm in Toronto caused $647 million in damages, including destruction of this culvert (left, $4 million) in losses, which was replaced with a larger, more resilient culvert (right). Source: Toronto Environment Office.

Photo credit for damaged culvert: Jane-finch.com.

Photo credit for new culvert: City of Toronto Transportation Services.
FEMA initially denied reimbursement for larger culvert. Ongoing challenge with site-specific design flexibility vs. uniform application of a law. Georgetown Climate Center is preparing a case study (and provided these photos).

VTRANS: Rivers & Roads Training
*Design, maintain, operate with the rivers foremost in mind.*
4. WHAT’S NEEDED FOR IMPLEMENTATION?

RESILIENCE AND ADAPTATION PLANNING

- Measure and document past events and impacts
  - Physical, operations, economic
- Project future impacts
- Assess vulnerabilities
- Evaluate resilience strategies
- Gauge available resources and capabilities
- Engage stakeholders throughout
- Identify and pursue implementation opportunities
CHALLENGES

• **Analytical**
  – Physical impacts: System and model interactions
    • E.g., SLR + projected storms → surge → topography → flooding
    • Infrastructure interdependencies
  – Economic
    • Opportunity costs of impacts (business interruption, infrastructure…)
    • Costs and benefits of resilience measures

• **Institutional, Policy/Legal, Budgetary**
  – Conflicting goals or requirements (government, private sector, community)
  – Agreeing on risk tolerances, critical infrastructure
  – Stakeholder agreement on implementation and funding priorities
  – Staff capacity and availability
  – Restrictions on use of rebuilding funds
  – Limited funds to invest
Climate Adaptation and Transportation: Information & Assistance Needs CCAP & EESI for NOAA

2012 Report from expert workshop (Nov. 2011)
Climate Adaptation and Transportation Information & Assistance Needs CCAP/EESI for NOAA (2012)

1. Information on local, non-climate factors can be more important than climate science information.
   - Adaptation starts with determining how well critical infrastructure is adapted to *current* climate and weather
   - Infrastructure elevation, state of repair, culvert capacity
   - Land development trends
   - Natural factors: soil saturation, tide levels, river flows
   - Interactions, cascading impacts
2. Improve climate & weather information products
   - Precipitation Intensity Duration Frequency (IDF) curves (Atlas 14)
     • Keep updated for all regions
     • Add climate change projections
   - Update flood maps taking climate scenarios into account
   - Extreme events: enhanced spatial & temporal information
   - Standardize sea-level rise GIS data
   - Updated LiDAR elevation data
3. Communication
   - Need central clearinghouse of data, information, guidance
   - Clear summary of who’s doing what, where to find what you need
   - Best practices
   - Help navigating tools, models data

4. Education
   - Definition of critical assets
   - Increase comfort in applying projections instead of historical data
   - Peer exchange
5. More and Better Tools

- **Integrate climate decision making into existing processes**
- Scenario analyses and planning
  - Determining *thresholds* and decision points
  - Determining *timing* of decisions, actions
  - Assessment of multi-sector interdependencies
- **Evaluating costs and benefits** of adaptation measures
- **Managing risk and uncertainty**
  - Guidance on operationalizing responses to probability ranges
  - When are directionally-correct measures enough?
6. Research Needs

- Small scale events don’t get enough attention
  - Can be significant in terms of storm water management
- Projected extreme events at higher time resolution
  - Hydraulic engineers interested in events of 6-hour or less
- Relating projected model results for precipitation to flow/runoff
  - Integrate with land use changes and other projected changes
7. Engage Stakeholders

- Present images of problems and common-sense solutions
- Relate it to stakeholder priorities: Economic, Quality of Life
  - Economic costs & benefits for government, business, individuals

Growing Wealthier Matrix

<table>
<thead>
<tr>
<th>Business</th>
<th>Household</th>
<th>Municipal &amp; Regional</th>
<th>National</th>
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<tbody>
<tr>
<td>Return on Investment</td>
<td></td>
<td></td>
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<tr>
<td>Access to new markets</td>
<td>Enhance or preserve housing values</td>
<td>Higher public revenues</td>
<td>More efficient use of transportation investments</td>
</tr>
<tr>
<td>Reduced investment risks</td>
<td>Reduced citizen opposition to development</td>
<td>Attracts private investment</td>
<td></td>
</tr>
<tr>
<td>Construction &amp; transit jobs</td>
<td>Better access to jobs</td>
<td>More efficient economy</td>
<td></td>
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<tr>
<td>Higher property values</td>
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<tr>
<td>Productivity enhancements due to agglomeration</td>
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<tr>
<th>Savings on Expenditures</th>
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<tbody>
<tr>
<td>Employee health care savings</td>
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<tr>
<td>Better information &amp; decision making</td>
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<tr>
<td>Reduced parking requirements</td>
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<tr>
<td>Reduced energy &amp; water use</td>
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<tr>
<th>Improved Quality of Life</th>
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<tbody>
<tr>
<td>Quality places attract high quality workers</td>
</tr>
<tr>
<td>Improved environment for small businesses</td>
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8. Recommendations for Federal Agencies

- **Research and Analysis**
  - Costs and benefits of resilience measures
  - Data improvement
  - Risk management methods
  - Transportation structure, component, and material vulnerabilities

- **Capacity Building**
  - Technical assistance (planning, design, construction, maintenance)
  - Selecting and applying data and analytical tools
  - Evaluation of measures (effectiveness, costs, benefits)

- **Policy**
  - Integrating adaptation into planning processes, asset management
  - Integrate adaptation with other environmental goals (GHG mitigation)
  - Performance management guidelines on climate resilience
• Transportation practitioners need help making decisions with imperfect data and perpetual uncertainty.

• They already have much of the relevant experience
  – Hazard mitigation, emergency response, flood management, land use planning

• You can’t always get what you want
  \[ \text{but if you try sometime,} \]
  \[ \text{you just might find} \]
  \[ \text{you get what you need.} \]
  – Mick Jagger
WHAT’S NEW?

• Growing number of reports, tools and resources
  – USDOT, EPA, NOAA, TRB, NCHRP, AASHTO, CALTRANS, Georgetown…

• More and better plans, reports, pilots
  – PlaNYC
  – Sandy Task Force
  – FHWA and FTA state, MPO and local pilots

• New and evolving Federal policies
  – President Obama’s Climate Action Plan
  – US Army Corps North Atlantic Coast Comprehensive Study
**SOME RESOURCE HIGHLIGHTS**

- **Federal Highway Administration**
  - [Climate Change & Extreme Weather Vulnerability Assessment Framework](#)
  - [Gulf Coast Study](#)
  - [Climate change resilience pilots](#) (SF, NJ, VA, WA, TN, MI, TX, ME, AZ, AK, CT, MA, S. FL, CA, MN, NY, OR, WA, IA, MD)

- **Federal Transit Administration**
  - [Flooded Bus Barns and Buckled Rails](#)
  - [Pilots](#) (Atlanta, LA, Chicago, Seattle, Houston, Tampa, San Fran, Philly)

- **Transportation Research Board**
  - [Climate Change, Extreme Weather Events and the Highway System: A Practitioner’s Guide](#) (*NCHRP20-83(05)*)
    - Forthcoming decision support software tool system
  - Pre-Event Recovery Planning Guide for Transportation ([NCHRP Report 753](#))

- **Engineers Canada**
  - [Public Infrastructure Engineering Vulnerability Committee](#) Engineering Protocol
POLICY AND PLAN RECOMMENDATIONS

• **PlaNYC** transportation strategies
  – Integrate climate resiliency into future capital projects
  – Elevate traffic signals, provide backup power, flood protection for tunnels
  – Expand services to increase system flexibility and redundancy

• **Hurricane Sandy Rebuilding Task Force**
  – Promote resilient rebuilding based on locally-driven solutions
  – Ensure coordinated approach to infrastructure investment (Fed, private, state, local)
  – Enhance local capacity for resiliency planning and implementation

• **President Obama’s Climate Action Plan**
  – Integrate climate risk-management into infrastructure planning
  – Consistent approach to sea-level rise and flooding in federally-funded projects
  – Provide a toolkit for climate resilience

• **STRONG Act** *(proposed by Sen. Gillibrand (S. 904), Rep. Peters (H.R. 2322))*
  *Strengthening The Resiliency of Our Nation on the Ground*
  – Gap & overlap analysis of federal resilience efforts
  – Interagency Extreme Weather Resiliency Action Plan
  – Equip state, local and private decision-makers to enhance resiliency
• **Examples** of transportation-adaptation activities: MPOs / State DOTs (For FHWA case studies)

• **Federal support needs** (for the Kresge Foundation)
  – What do MPOs and state DOTs need from federal agencies?
  – What federal programs are being used to support adaptation?
  – What barriers are being encountered?
  – How to consider climate change in MAP-21 risk-based management plans?

Please send any suggestions, comments, or questions to: lynch@law.georgetown.edu
6. CONTINUING PROGRESS

• **Be Strategic and Opportunistic**
  – Pursue comprehensive planning and analysis,
  – **But** follow the money and stakeholder priorities
    • That’s where short-term progress can be made
    • Common-sense goes a long way in answering the Climate Question

• **Collaboration is key**
  – Within organizations, among organizations and sectors
  – More and more federal, state, local, private collaboration
    • **FHWA** and **FTA** pilots
    • **Sandy Task Force**
    • **Washington DC**: DDOE, OP, NCPC, NASA, EPA, MWCOG, Pepco, BIDs, CCAP, Georgetown..
    • **MA**: MassDOT, Executive Office of Energy & Environmental Affairs, Boston, Cambridge, Boston Water and Sewer, Boston Harbor Assoc, UMass, CERES…
    • **SE. Florida**: Broward, Miami-Dade, Monroe, Palm Beach, NOAA, USACE, USGS, USEPA…
CCAP’s “PIE” framework - People, Infrastructure and Economy – *align integrated climate planning with policy and community priorities.*
A dollar spent on hazard mitigation saves society an average of $4.
~ Multihazard Mitigation Council
We tend to spend more cleaning up after disasters than planning ahead to prevent future losses.

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<tr>
<th>Scenario</th>
<th>Losses</th>
<th>Preventative Measure</th>
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<tbody>
<tr>
<td>Sandy, NYC (2012)</td>
<td>$19B</td>
<td>$20B (PlaNYC)</td>
</tr>
<tr>
<td>Katrina, New Orleans</td>
<td>$150B</td>
<td>$30B (Amsterdam-style flood controls)</td>
</tr>
<tr>
<td>1.4m Sea Level Rise, San Francisco</td>
<td>$62B</td>
<td>$5B (Flood defense)</td>
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Swiss Re analysis for PlaNYC based on hurricane models, climate change scenarios and city-level asset and economic activity.

• Sandy losses in NYC: $19 billion
  ($13 B physical, $6 B lost economic activity)

• Considered a “1-in-70” year event (1.4% chance)

• In 2050 $19 billion loss will be a 1-in-50 yr event (constant $)

• A 1-in-70 yr event in 2050 will cause a $90 billion loss
  – More than 4-times as much
Advancing Adaptation – Mitigation Synergies:

**Climate Adaptation**
- Investing in natural and built infrastructure
- Change in land use, relocation
- Residential programs promoting adaptation
- Emergency & business continuity planning
- Health programs

**Greenhouse Gas Mitigation**
- Energy conservation & efficiency
- Renewable energy
- Sustainable transportation, improved fuel efficiency
- Capture and use of landfill and digester gas
- Carbon sinks

- Green Infrastructure
- Power System Resilience
- Protect Sustainable Transportation
- Water & Energy Conservation
- Building Weatherization
Green Infrastructure: Mitigate urban heat and stormwater

Building Weatherization: Improve energy efficiency & storm resilience

Micro Grids & Distributed Renewables: low-carbon, resilient power systems

Elevate Subway Grates: Protect Low-Carbon Transit from Flooding

Water Efficiency: Reduce Pumping Energy Use & Prepare for Declining Supplies
GLACIER BAY, ALASKA: THEN AND NOW

July 1984

2012 (US Dept of Interior Photo)
http://instagram.com/p/SdUoIZAu_n/
THANK YOU

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