



Climate Change Adaptation for Transportation Infrastructure

Anne Choate, January 13, 2010

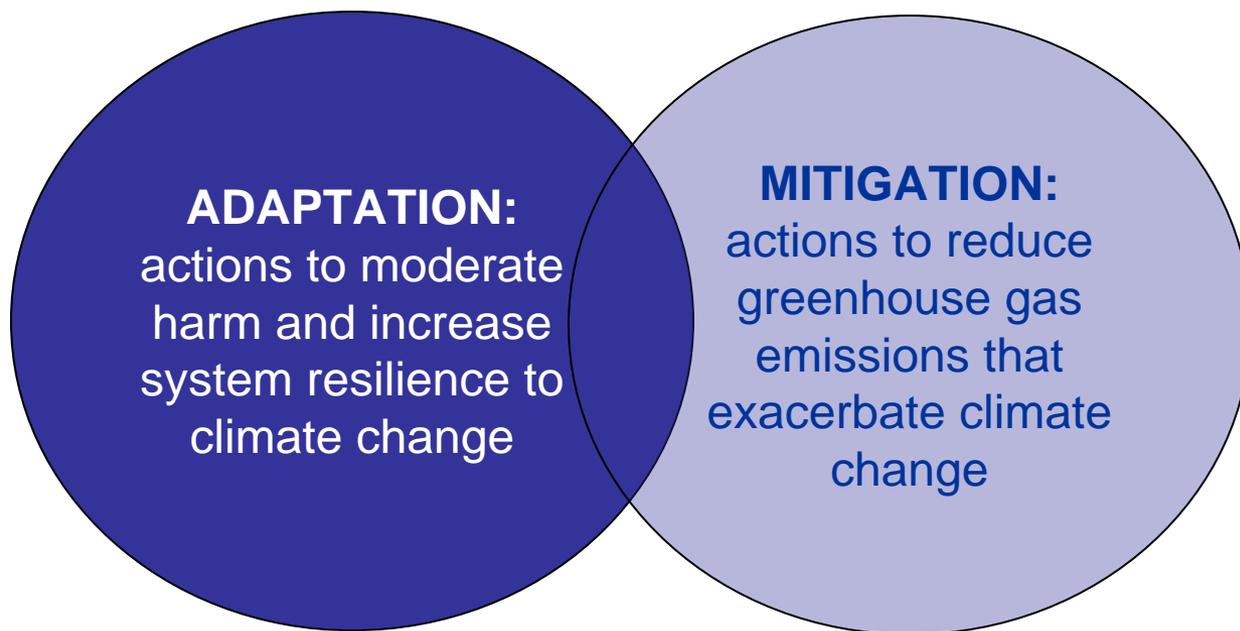
Transportation Research Board
Climate Change Joint Subcommittee of ADC70, ADC80



What is Adaptation to Climate Change?

- **Adaptation** is the process by which societies prepare for and minimize the negative effects of a variety of future environmental stresses on society
- **Mitigation** is the effort to slow and reduce the negative impacts of climate change by slowing the accumulation of greenhouse gases in the atmosphere

Adaptation is distinct from mitigation; so far, most transportation efforts have been focused on mitigation



Both are Important!

- David King, Chief Scientific Advisor to the UK government
 - *“It is unlikely that levels of greenhouse gases can be kept low enough to avoid a projected temperature rise of 2 °C”*

- John Holdren, Science Advisor, White House Office of Science and Technology Policy
 - *“We basically have three choices—mitigation, adaptation, and suffering. We’re going to do some of each. The question is what the mix is going to be. The more mitigation we do, the less adaptation will be required, and the less suffering there will be.”*

Outline

- Barriers to adaptation in transportation infrastructure
- Framework to streamline adaptation
- Efforts underway on adaptation and infrastructure
- Summary

Barriers to Adaptation

- Diverse decision makers with diverse capacity and information needs
- Perception of uncertainty is a hurdle
- Screening, assessing, and managing climate risks is complicated and resource-intensive
 - Developing planning-relevant climate change scenarios is a significant hurdle
 - Emphasis on long time-frames requires projecting not only climate, but also other long-term drivers difficult to foresee
 - Few damage functions or guidelines are available
 - Engineered structures often specify design standards in terms of intensity-duration-frequency targets (e.g., 100-year flood), and climate “stationarity is dead” (Milly et al. 2008)
 - Many climate risks have “low probability/ high consequence” characteristics
 - Little info is available on cost-effectiveness of adaptation options
 - Little info is available on costs of inaction
 - The benefits of adaptation are largely unproven

Barriers to Adaptation

- In a world of limited resources, adaptation looks scary, time-consuming, and of questionable value

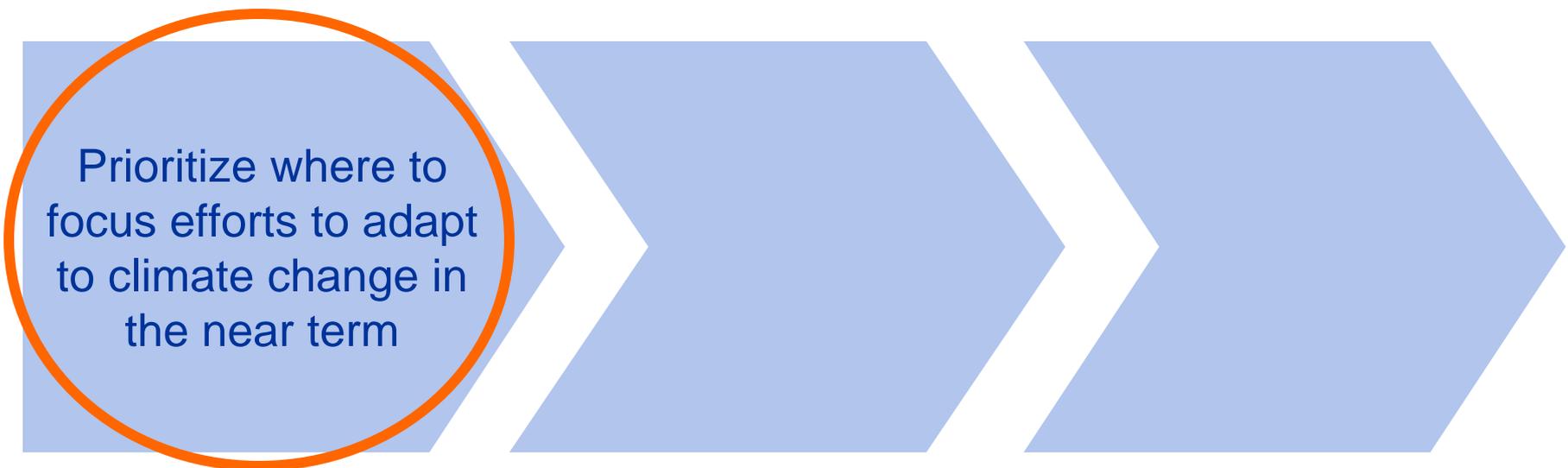
How can we streamline adaptation in transportation infrastructure design, planning, asset management, and operation/ maintenance?

Framework for Streamlining Adaptation

1 - Risk Screening

2 - Risk Assessment

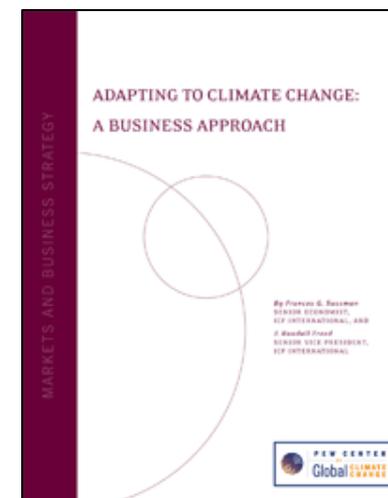
3 - Risk Management



Prioritize where to focus efforts to adapt to climate change in the near term

Risk Screening: Where Does Climate Have a Role?

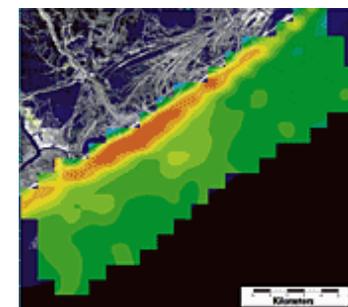
- How sensitive is the asset/ system to climate change?
 - Is climate a factor now?
 - Will changes in average climate—or in the “tails”—be a factor?
- What is at stake if a wrong decision is made?
 - Impacts/damages of climate potentially high?
 - Damages irreversible or difficult to reverse?
 - Is the asset / system critical?
 - Is capital investment large?
 - Can negative effects of climate be ameliorated by possible adaptive action?
- Timing and time horizon: is there a need to take immediate action?
 - Is there an immediate threat based on current conditions?
 - Are decisions being made now that will govern actions for sometime to come, or do decisions take time to be implemented?



Risk Screen: Output

- Group 1: climate change is not a key stressor
- Group 2: climate change could become important, but options remain open to adapt in the future – monitor and revisit periodically
- Group 3: assess risks and start managing them now
 - Climate change risks are significant relative to other stressors
 - Planning and implementation life-cycles are long, or plans are difficult to adjust once in place
 - Resource value or project costs are high
 - Institutional resources are available to manage risk

What, Me Worry?



Even without detailed climate projections, asset/ system managers can use the screen to determine whether detailed climate change risk assessment and management (e.g., engineering analysis) is warranted

Examples of Potential Candidates for Adaptation Planning in the Short-term

- High-cost, long-lived infrastructure programs
 - Energy generation and transmission infrastructure
 - Transportation system design
 - Wastewater treatment and drinking water treatment design and siting
 - Flood control programs
- Long-term programs with high cost of failure/ difficult to reverse decision
 - Land use planning/ zoning
 - Transportation plans
- High-value programs with high cost of failure
 - Emergency management and communication plans
 - Insurance programs

Framework for Streamlining Adaptation

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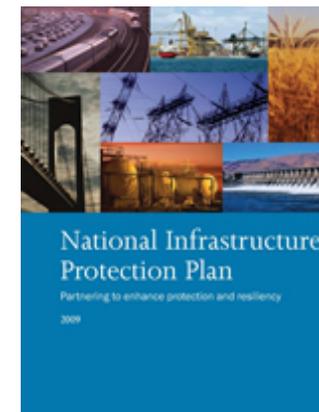
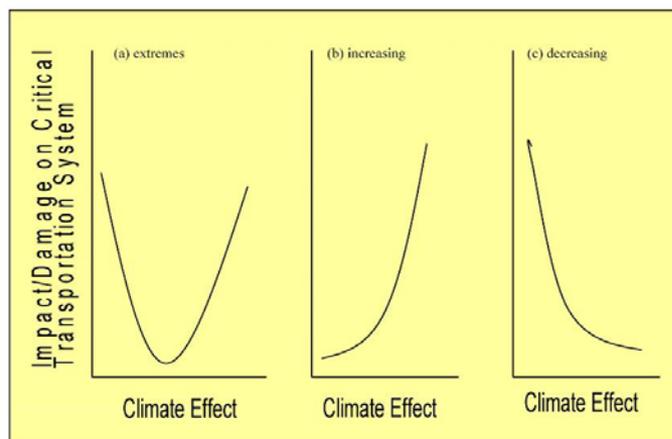
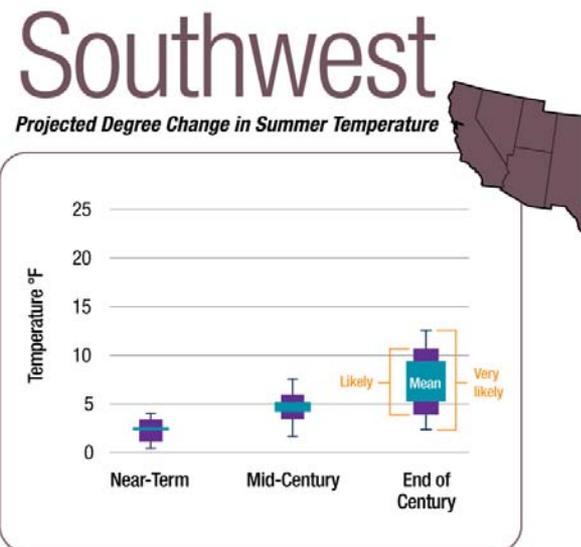
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Prioritize where to focus efforts to adapt to climate change in the near term

Assess the impacts of stressors to inform management decisions

Risk Assessment Tools

- Climate effect scenarios (e.g., FHWA climate effects typology)
 - Sea level rise (inundation, storm surge)
 - Temp (mean and extremes)
 - Precip (mean and extremes)
 - Flows (mean and extremes)
- Damage functions (translating effects to impacts)
 - Endpoints
 - Functional form
 - Effect/damage relationship – probability and consequence
 - Use existing frameworks to extent possible (e.g., NIPP)



Framework for Streamlining Adaptation

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3 - Risk Management

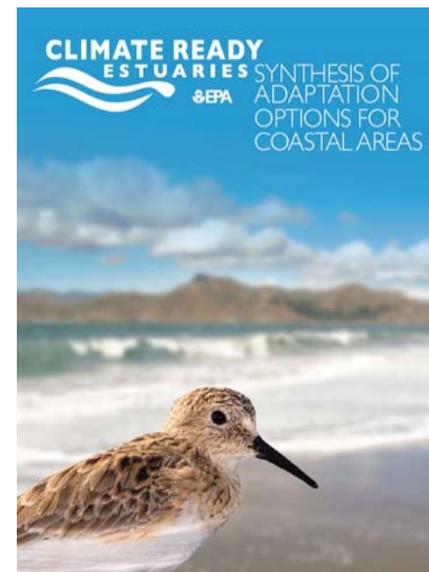
Prioritize where to focus efforts to adapt to climate change in the near term

Assess the impacts of stressors to inform management decisions

Take action to reduce impacts or exploit beneficial opportunities

Risk Management Tools

- Lists of options
 - By type of damage
 - Conditions for suitability
- Cost models
 - First order cost estimates
- Effectiveness models
 - How much do the options reduce climate risk?
 - To what extent are there co-benefits?
 - What is the cost of inaction?
- Methods to characterize uncertainty
 - Key sources
 - Comparison to “familiar” sources of uncertainty



Current Efforts on Adaptation and Infrastructure

Initiative	Improving Risk Assessment Methods	Risk Management Assistance to Decision Makers	Communication/ Outreach	Resources for Adaptation
Private sector efforts	✓			
Municipal action plans	✓	✓		
State action plans/initiatives	✓	✓	✓	
Federal Sectoral Programs	✓	✓	✓	
Climate-ready Estuaries (Fed)	✓	✓	✓	
Climate-ready Utilities (Fed)	✓	✓	✓	
American Clean Energy & Security Act				✓
American Recovery & Reinvestment Act				✓

Summary

- Climate change adaptation is relevant to some – but not all – transportation infrastructure planning and design
 - A risk screening process can help identify high priorities for detailed risk assessment and management
- For infrastructure, detailed assessment and management of climate-related risks is complex and involves considerable uncertainty ...
 - ... which makes it just like analyzing risks from many other, more familiar stressors
 - ... which benefit from the availability of frameworks and info and familiarity with them
- Efforts are underway to provide frameworks and info
- If a climate bill is enacted, state and local governments could have significant resources to address adaptation which would provide an impetus for improving climate risk assessment and management
- **As the US embarks on the biggest wave of investment in 70 years, we need to ensure that 21st century infrastructure is not designed for 20th century climate**

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