

Risks and Vulnerabilities for Coastal Areas & Ports:

Draft Findings from the National Climate Assessment Coastal Chapter

Susanne C. Moser, Ph.D.

CLA – Coasts chapter

Member – NCADAC & Executive Secretariat

Susanne Moser Research & Consulting

Stanford University

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<http://assessment.globalchange.gov>

**Thank you to the
NCA cast of 1000s!**



Port of Long Beach

- NCA leadership
- NCA staff support, particularly Fred Lipschultz, Ralph Cantral, and Elizabeth Fly
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- The coastal chapter author team (and contributors)
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- CLAs of other chapters for horse-trading and compromise
- Public and agencies for review comments

Overview

- **The NCA Coastal Chapter**
 - Development
 - Inputs
 - Draft Key Findings
- **Relevance to California Ports & Harbors**
 - California-specific Climate Change Risks for Coasts
 - Planning and Preparing for Impacts in California
 - Ports' Adaptation Efforts to Date

Introducing the Author Team: Coastal Zone, Development and Ecosystems



- **Convening Lead Authors**
 - Susi Moser (Susanne Moser Research & Consulting and Stanford University)
 - Margaret Davidson (NOAA)
- **Lead authors**
 - Paul Kirshen (Univ. of New Hampshire)
 - Peter Mulvaney (Skidmore, Owings & Merrill LLP)
 - Jim Murley (South Florida Regional Planning Council)
 - Jim Neumann (Industrial Economics, Inc.)
 - Laura Petes (NOAA)
 - Denise Reed (Water Research Institute of the Gulf)



Timeline of Chapter Development

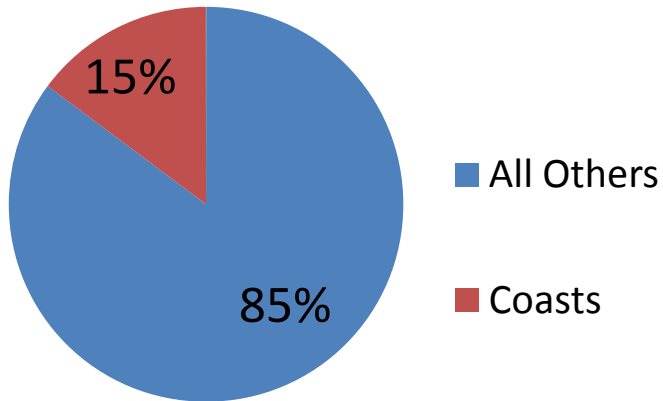


**National
Climate
Assessment**

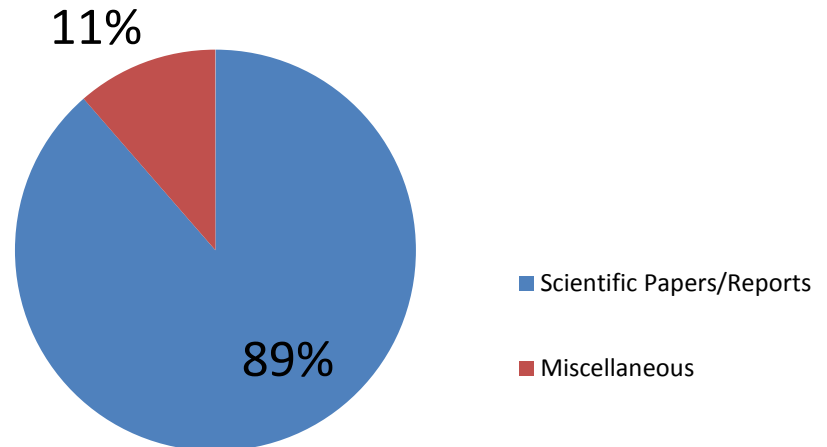
U.S. Global Change Research Program

Coastal Zone, Development and Ecosystems: Technical Inputs Received

All Technical Input Reports



Types of Reports



Oceans and Marine Resources in a Changing Climate



Technical Input to the 2013
National Climate Assessment



EPA/600/R-11/058a | January 2012 | www.epa.gov

Vulnerability Assessments in Support of the Climate Ready Estuaries Program: A Novel Approach Using Expert Judgment

Volume I
Results for the San Francisco
Estuary Partnership



United States Environmental Protection Agency
Office of Research and Development, National Center for Environmental Assessment

Past and Projected Trends in Climate and Sea Level for South Florida



Hydrologic and Environmental Systems Modeling

Technical Report

July 2011



Stories of Change: Coastal Louisiana Tribal Communities' Experiences of a Transforming Environment



Grand Bayou Village
Grand Caillou/Dulac Band of the Biloxi-Chitimacha Confederation of Muskogees
Ile de Jean Charles Band of the Biloxi-Chitimacha Confederation of Muskogees
Ponchartraine Indian Tribe
January 22-27, 2012

Coastal Impacts, Adaptation and Vulnerabilities



A Technical Input to the 2013
National Climate Assessment



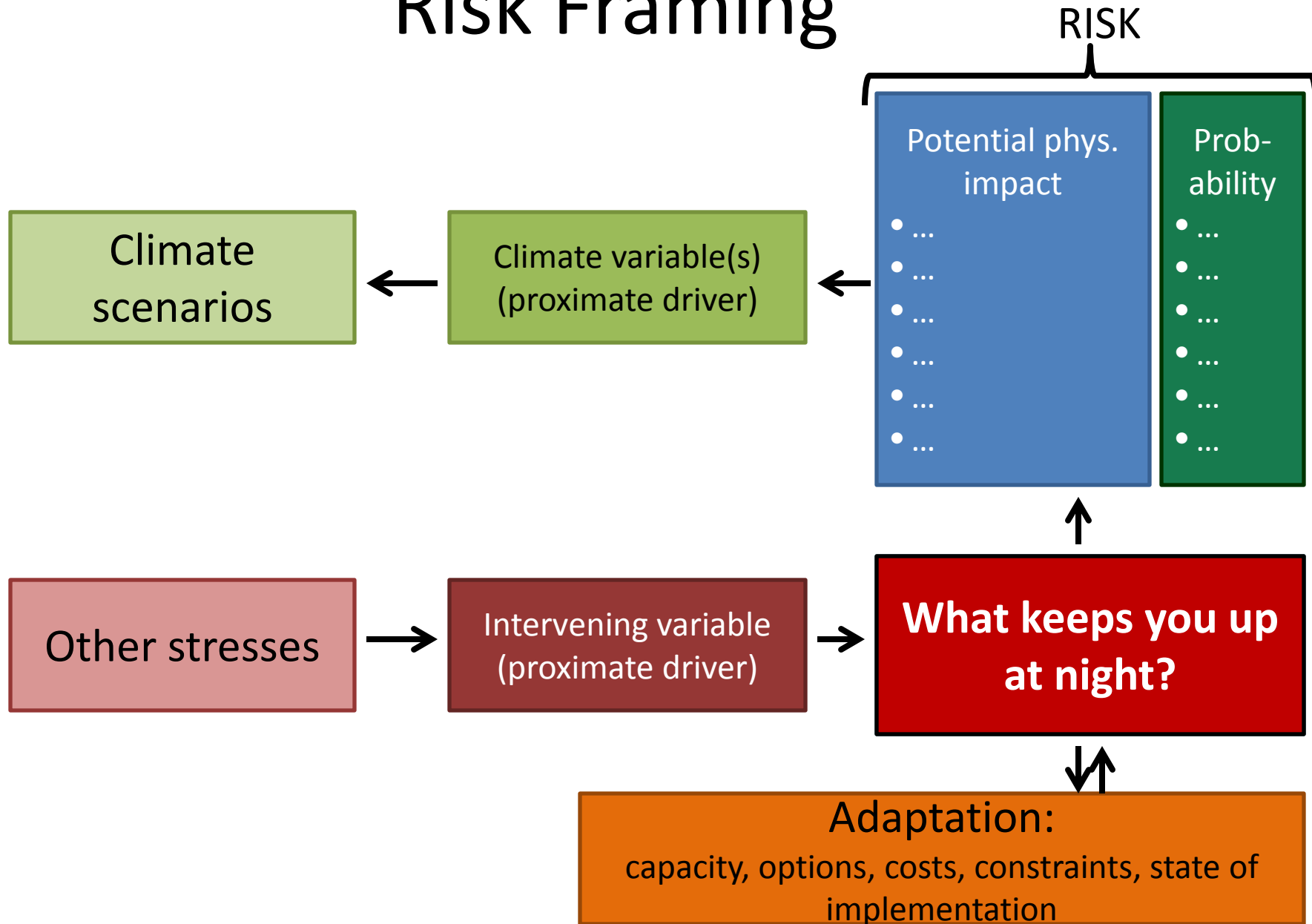
Climate Change and Energy Supply and Use

Technical Report to the
U.S. Department of Energy in Support
Of the National Climate Assessment

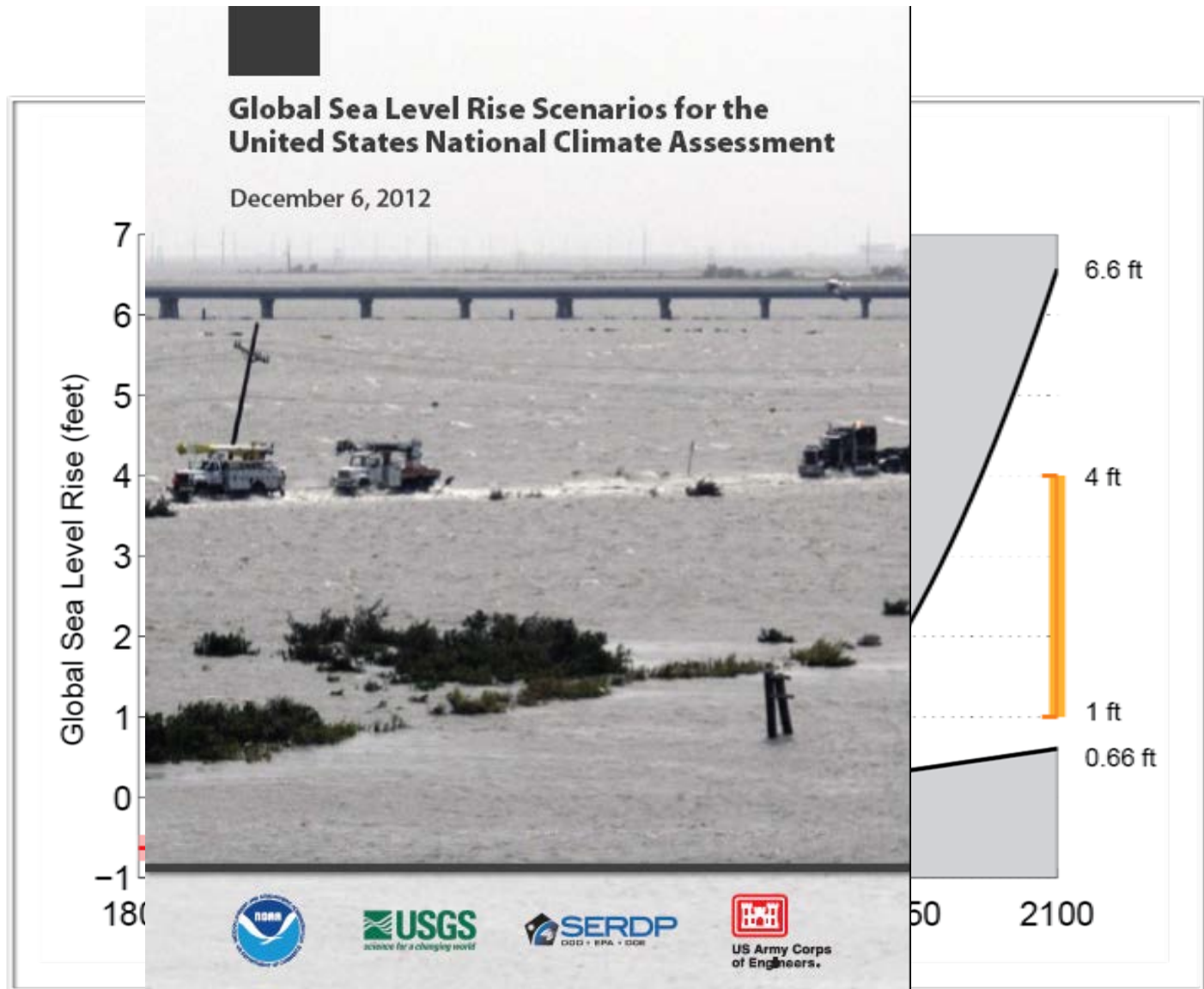
29 February 2012



Risk Framing



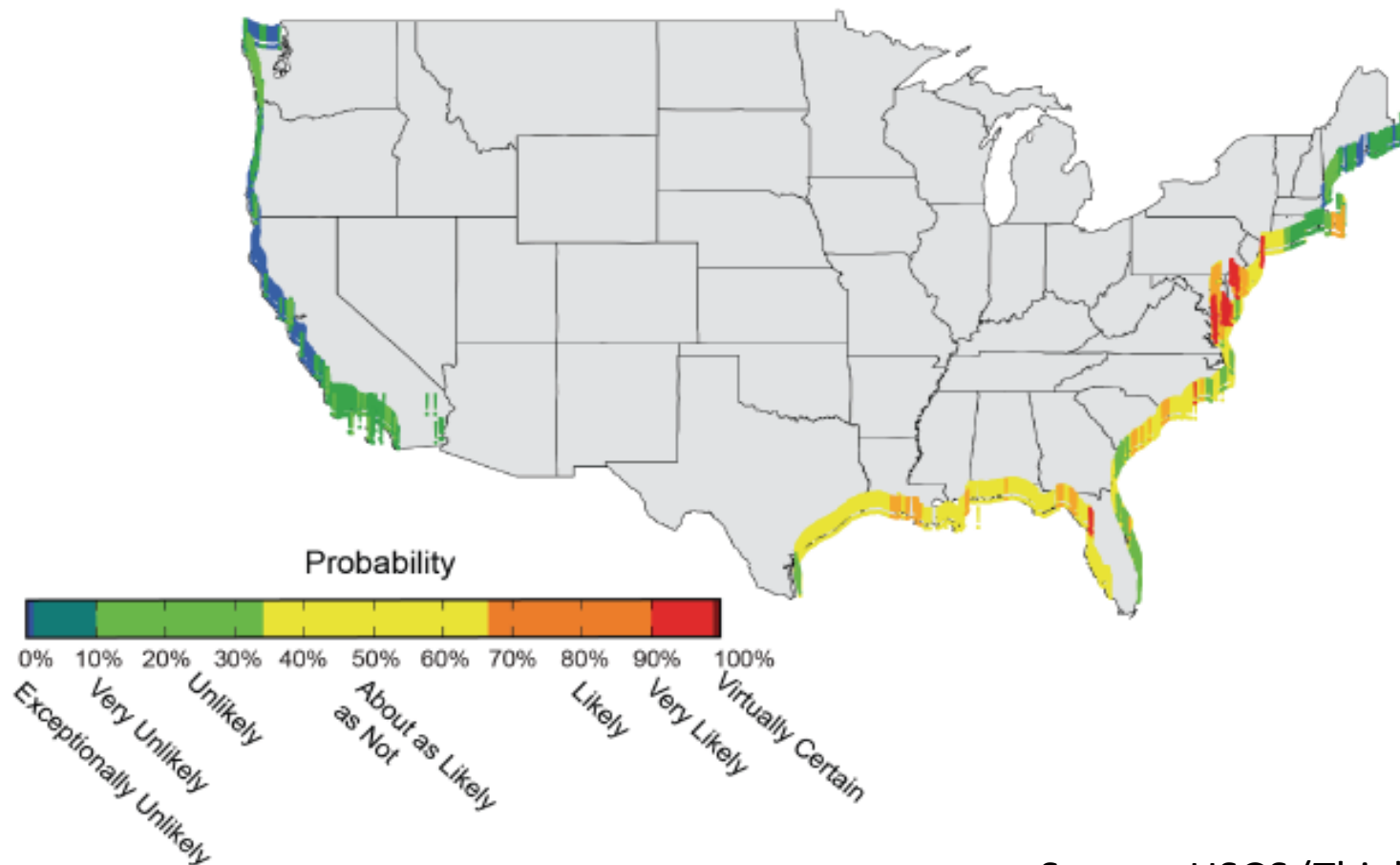
Sea-Level Rise Scenarios



Source: Parris et al. (2012), Chapter 2 of Draft NCA report

Historical SLR -> Shoreline Change

Probability of Shoreline Erosion >1 m/yr



Source: USGS (Thieler et al.)

Other Relevant Considerations

- Regionally specific non-climatic factors
 - Land movement
 - Physical/ecological character of coast
 - Historical trends
 - Concurrent non-climatic stressors
- Regionally specific climatic changes
 - Temperature and precipitation changes
 - Sea ice/lake ice changes
 - Storminess



Regional Differences in Climate Change Threats

PACIFIC NORTHWEST

- Sea level rise is moderated by the continuing uplift of land, with few exceptions, such as the Seattle area.
- Commercial shellfish populations are susceptible to shell thinning from ocean acidification.
- The region's relatively high economic dependence on commercial fisheries makes it sensitive to climate change impacts on marine species and ecosystem and related coastal ecosystems.

GREAT LAKES

- Higher temperatures and lengthened growing seasons in the Great Lakes region favor production of blue-green and toxic algae that can harm fish, water quality, habitat, and aesthetics.
- Increased winter air temperatures led to decreased Great Lakes ice cover, making shorelines more susceptible to erosion and flooding.
- Current projections of lake level changes are uncertain.

NORTHEAST

- Highly built-up coastal corridor concentrates population and supporting infrastructure.
- Storm surges from northeasters and hurricanes can cause significant damage.
- The historical rate of relative sea level rise varies across the region.
- Wetlands and estuaries are vulnerable to inundation from sea level rise; buildings and infrastructure are most vulnerable to higher storm surges as sea level rises.

CALIFORNIA

- Sea level has risen approximately 7 inches from 1900 to 2005, and is expected to rise at growing rates in this century.
- Higher temperatures, changes in precipitation, runoff and water supplies, and saltwater intrusion into coastal aquifers will result in negative impacts on coastal water resources.
- Coastal storm surges are expected to be higher due to increases in sea level alone, and more intense "atmospheric river systems" will increase coastal flooding risks from inland runoff.
- Expensive coastal development, critical infrastructure, and valuable coastal wetlands are at growing risk from coastal erosion, temporary flooding, and permanent inundation.

MID-ATLANTIC

- Rates of local sea level rise in the Chesapeake Bay are greater than globally averaged ones.
- Sea level rise threatens coastal homes, infrastructure and commercial development, including ports.
- Chesapeake Bay ecosystems are already heavily degraded, making them more vulnerable to climate-related impacts.
- Climate change and ocean acidification pose threats to Chesapeake Bay fisheries.

GULF COAST

- Hurricanes, land subsidence and sea level rise already pose great risks to Gulf Coast areas, placing homes, critical infrastructure, and people at risk, and causing permanent land loss.
- Coastal inland and water temperatures are expected to rise; and coastal inland areas are expected to become drier.
- There is still uncertainty about future frequency and intensity of Gulf of Mexico hurricanes but SLR will increase storm surges.
- The Florida Keys and coastal Louisiana are particularly vulnerable to additional sea-level rise.

HAWAII & PACIFIC ISLANDS

- Warmer and drier conditions will reduce freshwater supplies on many Pacific Islands, especially on low lying islands and atolls.
- Sea level rise will continue at accelerating rates, exacerbating coastal erosion, damaging infrastructure and agriculture, reducing critical habitat, and threatening shallow coral reef systems.
- Extreme water levels occur when high tides combine with interannual and interdecadal sea level variations (e.g., ENSO, PDO, mesoscale eddy events) and storm surge.
- Coral reef changes pose threats to communities, cultures, and ecosystems.

ALASKA

- Summer sea ice is receding rapidly, altering marine ecosystems, allowing for greater ship access and offshore development, and making Native communities highly susceptible to coastal erosion.
- Ice loss from melting Alaskan and Canadian glaciers contributes almost as much to sea level rise currently as does melting of the Greenland Ice Sheet.
- Current and projected increases in Alaska's ocean temperatures and changes in ocean chemistry are expected to alter the distribution and productivity of Alaska's marine fisheries.

SOUTHEAST / CARIBBEAN

- A large number of cities, critical infrastructure, and water supplies are at low elevations and exposed to sea level rise.
- Ecosystems of the Southeast are vulnerable to loss from relative sea level rise, especially tidal marshes and swamps.
- Sea level rise will affect coastal agriculture through increasing the height of storm surge inundation, saltwater intrusion, and impacts on freshwater supplies.
- The number of land-falling tropical storms may decline, reducing important rainfall.
- The incidence of harmful algal blooms is expected to increase with climate change, as are health problems previously uncommon in the region.



Draft
static
graphic...
... will be
interactive

Draft Key Messages

1. Coastal lifelines, such as water supply and energy infrastructure and evacuation routes, are increasingly vulnerable to higher sea levels and storm surges, inland flooding, erosion, and other climate-related changes.

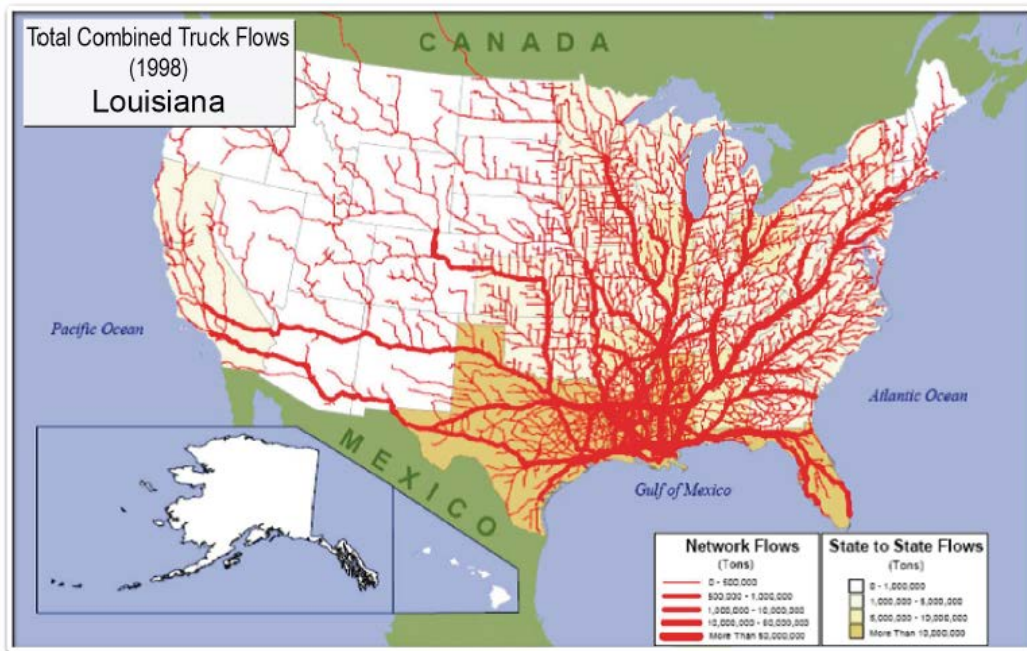


Source: LA1-Coalition

Caption: This “mock-up” photo shows the existing Highway LA-1 and Leeville Bridge in coastal Louisiana (on the right) with a planned new, elevated bridge that would retain functionality under future, higher sea level conditions (center left). A 7-mile portion of the planned bridge has been completed and opened to traffic in December 2011. (Source: LA1-Coalition)

Draft Key Messages (cont.)

2. Nationally important assets, such as ports, tourism and fishing sites, in already-vulnerable coastal locations, are increasingly exposed to sea-level rise and related hazards. This threatens to disrupt economic activity within coastal areas and the regions they serve, and result in significant costs for protecting or moving these assets.



Source: Department of Transportation (preliminary graphic)

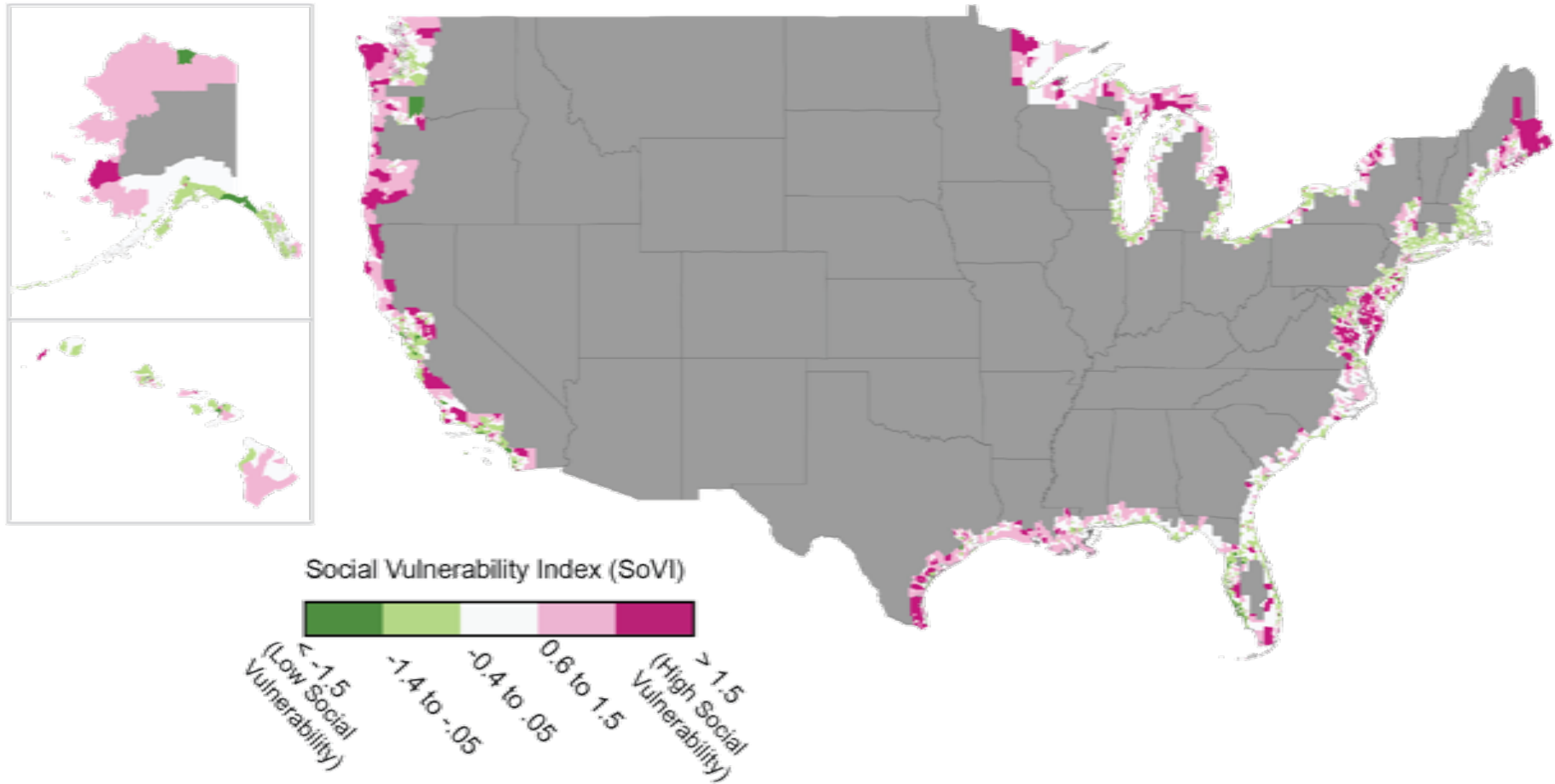
Draft Key Messages (cont.)

3. Socioeconomic disparities create uneven exposures and sensitivities to growing coastal risks and limit adaptation options for some coastal communities, resulting in the displacement of the most vulnerable people from coastal areas.



Sources (left, right): hamptonroads.com, aaas.org

Social Vulnerability



Source: Martinich et al. 2012

Draft Key Messages

(cont.)

4. Coastal ecosystems are particularly vulnerable to climate change because many have already been dramatically altered by human stresses; climate change will result in further reduction or loss of the services that these ecosystems provide, including potentially irreversible impacts.



Draft Key Messages (cont.)

5. Leaders and residents of coastal regions are increasingly aware of the high vulnerability of coasts to climate change, and are developing plans to prepare for potential impacts on citizens, businesses, and environmental assets. Significant institutional, political, social, and economic obstacles to implementing adaptation actions remain.



Adaptation Examples



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interactive



**What does this mean
to CA ports & harbors?**



Ports: Critical, complex, constrained

Critical - Economic engines at every scale

Complex – Multiple stakeholders across space and time

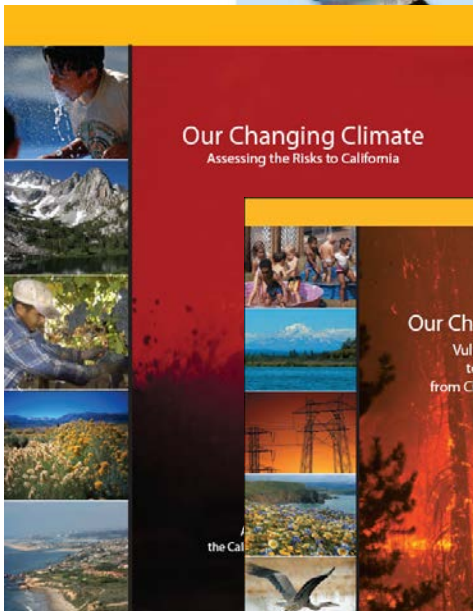
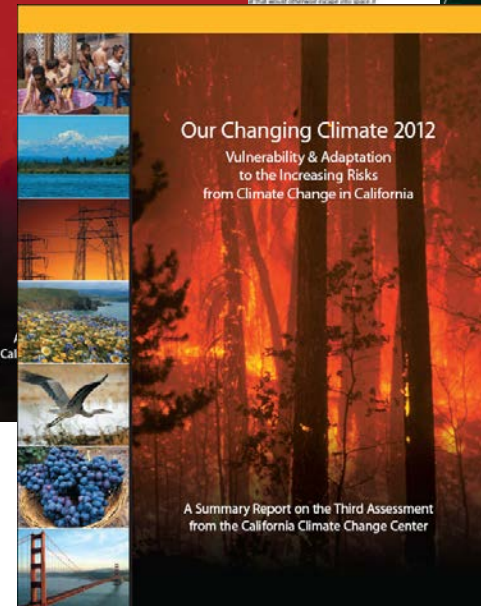
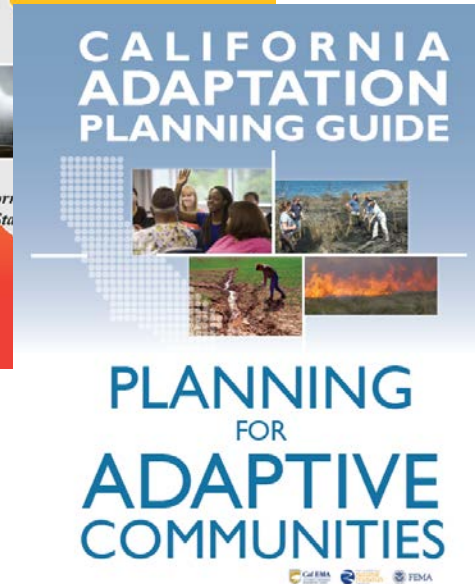
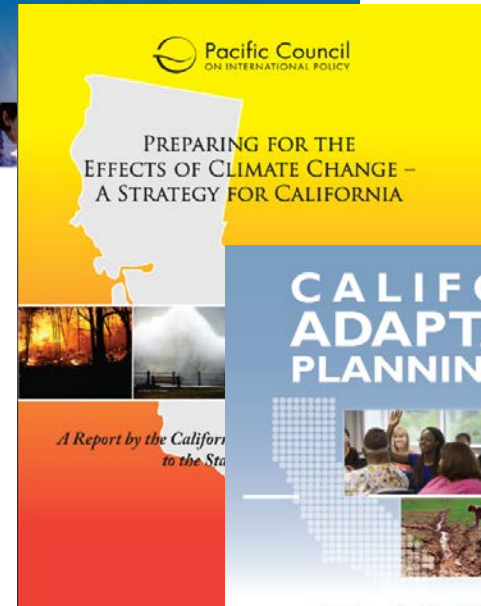
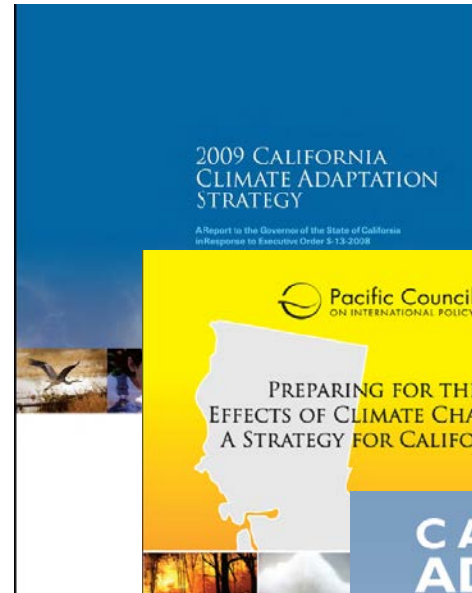
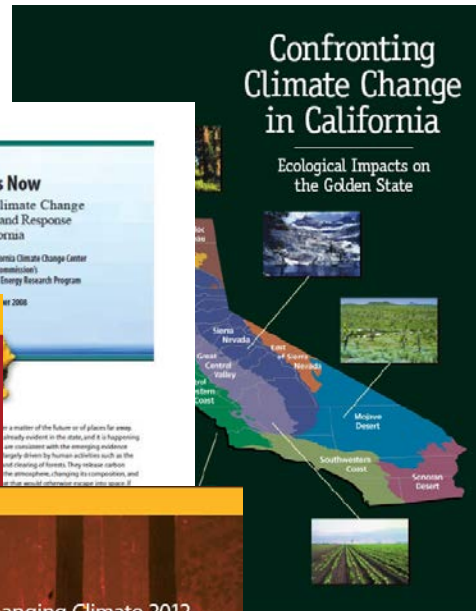
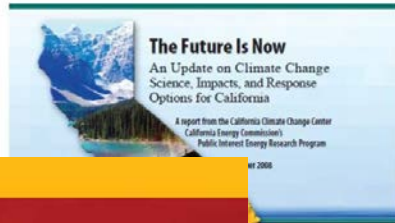
Constrained - Dependent on specific and environmentally-sensitive locations



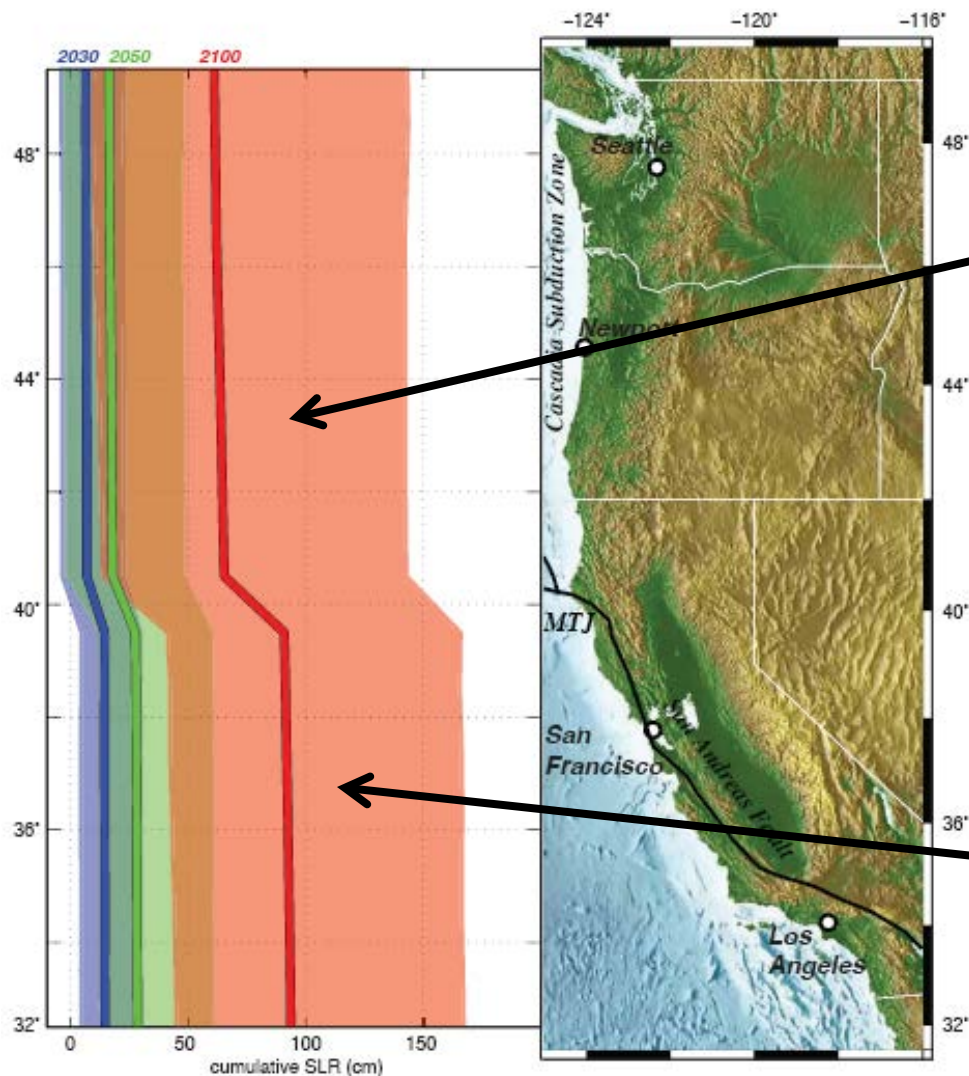
90% of US Consumer Goods Enter via Ports



Ongoing Research – Emerging Guidance



Sea-Level Rise Varies Along the Coast of California



SLR north of Cape Mendocino:

By 2030: -4–23 cm (up to 9 inches)
By 2050: -3–48 cm (up to 19 inches)
By 2100: 10–143 cm (4–56 inches)

SLR South of Cape Mendocino:

By 2030: 4–30 cm (1.6–12 inches)
By 2050: 12–61 cm (5–24 inches)
By 2100: 42–167 cm (16.5–66 inches)

Adaptation Leadership in CA

- **Local:** A growing number of municipal & county governments
- **Regional:**
 - Regional adaptation efforts
 - Alliance of Regional Collaboratives for Adaptation (ARCCA)
- **State:**
 - Ongoing scientific assessments
 - Adaptation Strategy 2009/2013
 - State agencies' guidance (Coastal Commission, BCDC, Coastal Conservancy, Dpt of Water Resources, etc.)
 - Governor's Office of Planning & Research
- **West Coast-wide collaboration:** West Coast Governors' Alliance on Ocean Health - Climate Change Action Coordination Team
- **Federal Agencies:** Pursuant to EO 13514
- **NGOs and universities:** Foundations, environmental NGOs, consultants, and scientists



Port Vulnerabilities

- Threats

- Periodic coastal flooding, intense rainfall and inland runoff
- Permanent inundation
- Storm surge and wave action
- Erosion

- Exposure

- Channel depth and sedimentation
- Access from land
- Elevation of infrastructure
- Elevation of on- and off-site storage facilities
- Elevation of other buildings
- Location of port-related energy storage and transmission facilities



Port of Oakland

- Sensitivity

- Age; design life
- Design standards
- Protective measures

- Adaptive Capacity

- Emergency preparedness
- Contingency plans
- Long-range plans
- Insurance

Example: Port of LA



Port of Los Angeles

- Commissioned RAND to assess whether SLR projections required upgrades of port infrastructure before end of design life

Example: San Francisco

- Local businesses signing long-term leases for Pier property will be exposed to growing risks from SLR; need to be informed; will require flood protection.
- Assessed risks from SLR
- Working with City toward adaptation strategy.



Chronicle / Darryl Bush

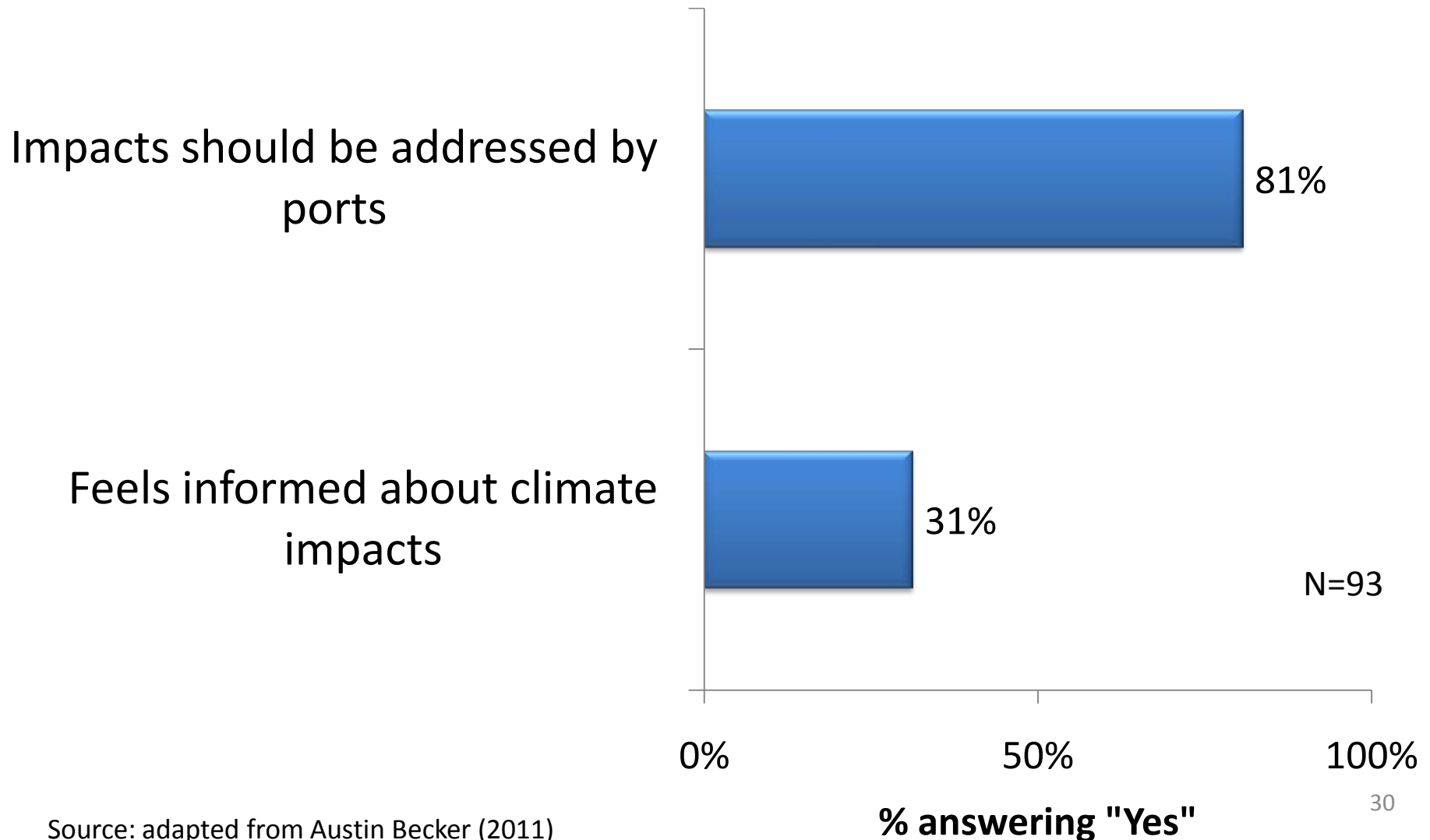
Example: San Diego



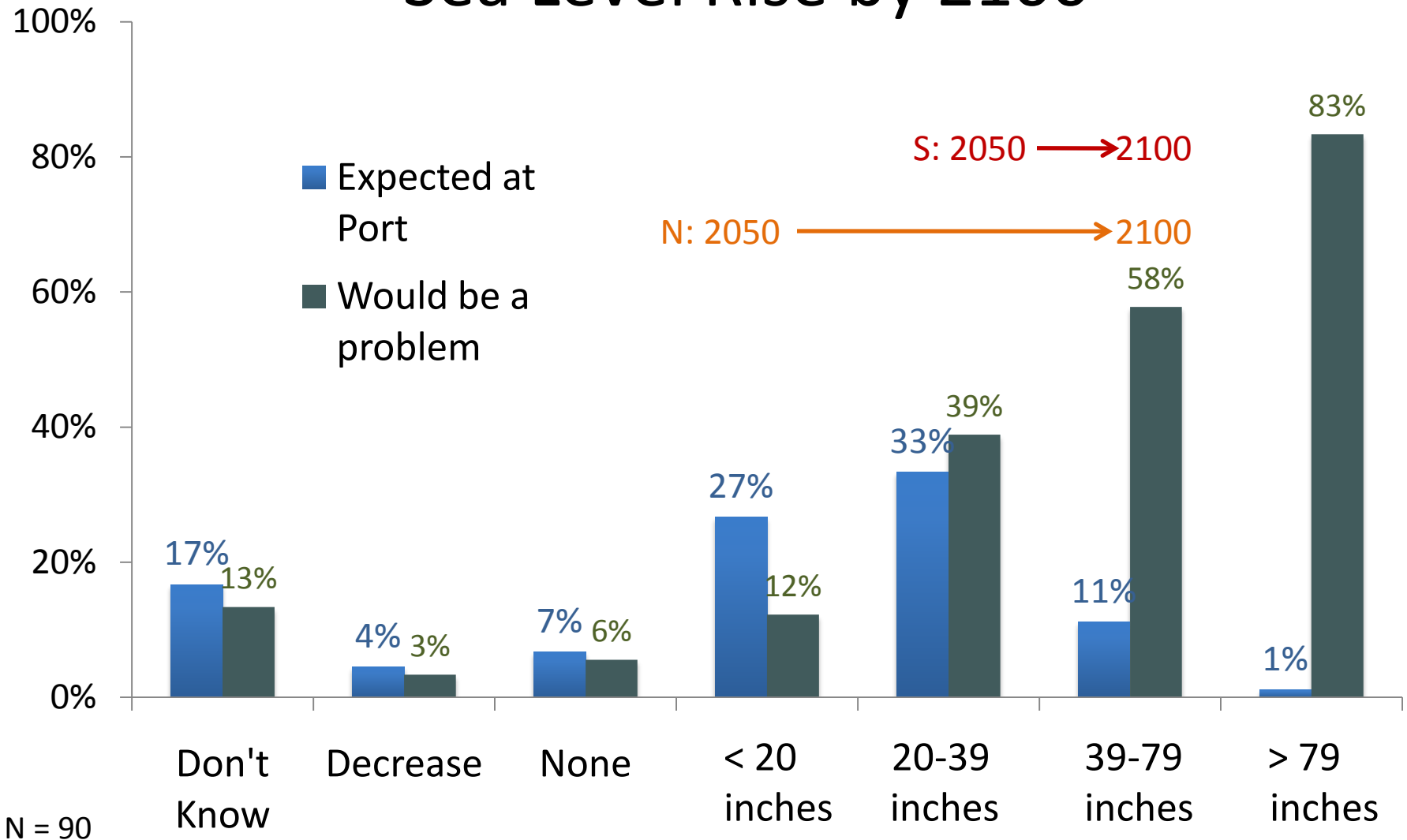
Port of San Diego and San Diego Bay

- Partnership with local, regional, state, and federal entities, NGOs and UCSD
- Vulnerability assessment
- Developing a climate action plan that involves mitigation and adaptation

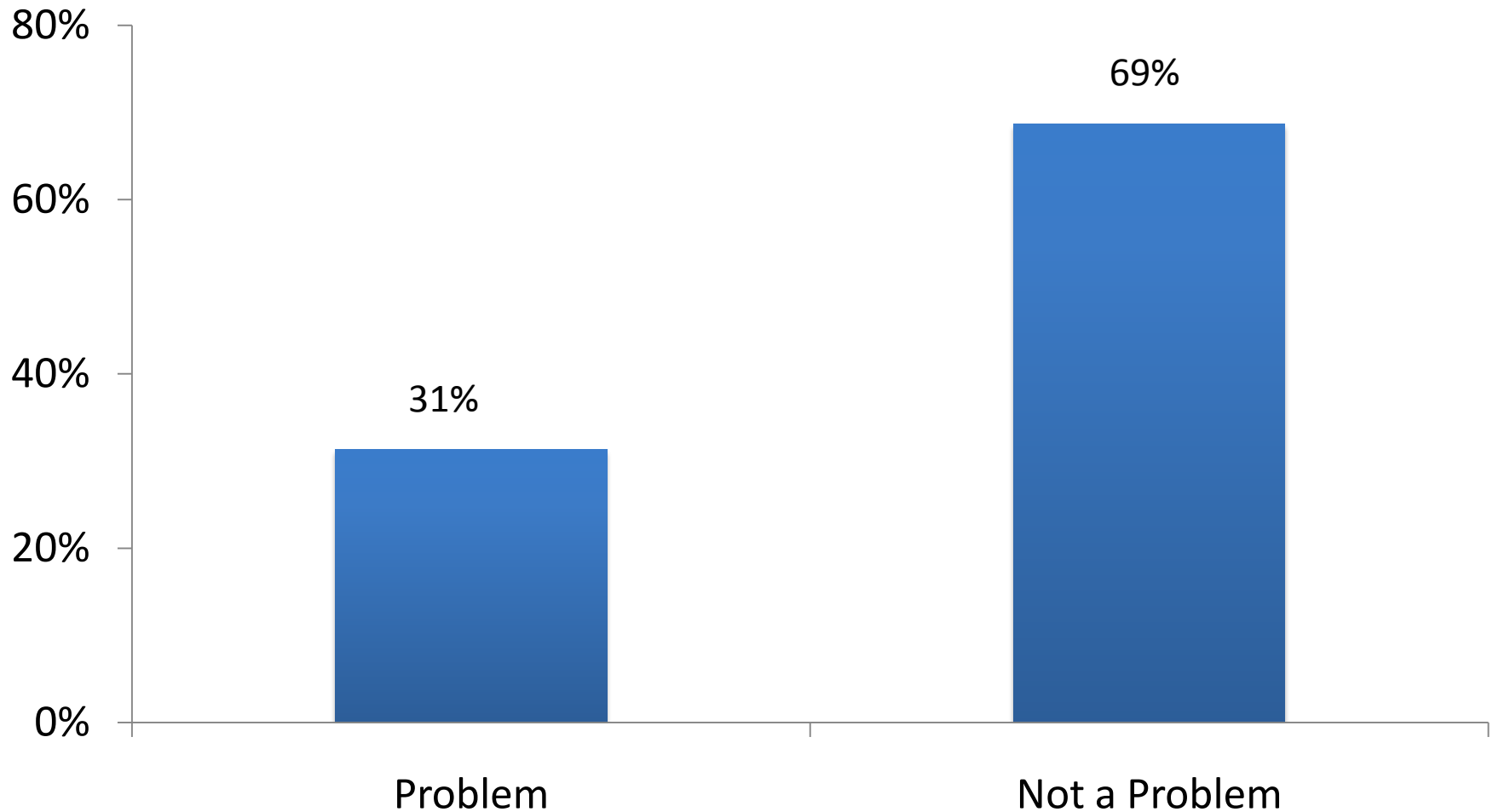
Ports Concerned, but Under-Informed



Port Authorities' Expectations about Sea Level Rise by 2100

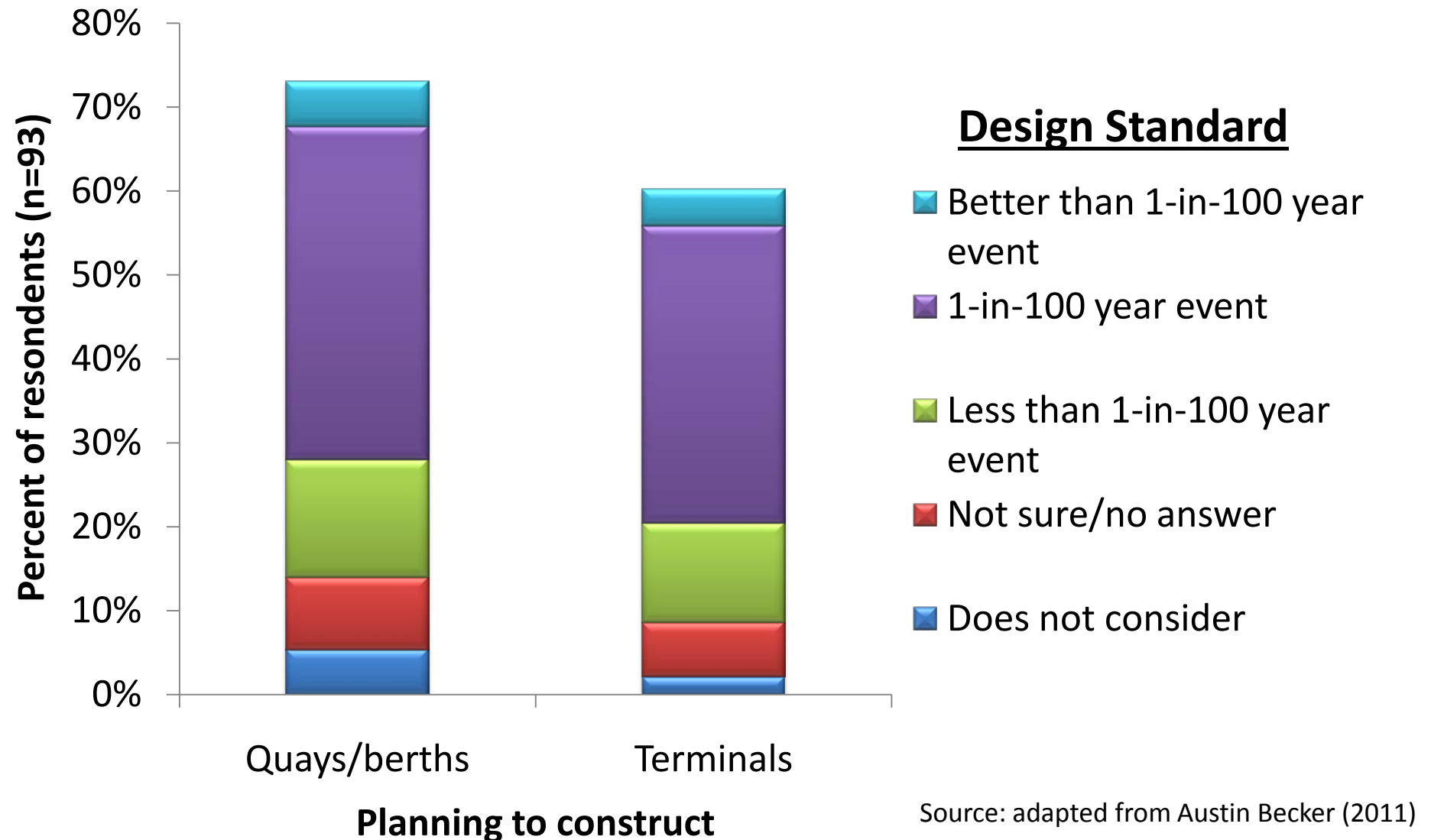


Will the Sea Level Rise You Expect By 2100 Be a Problem for Your Port?

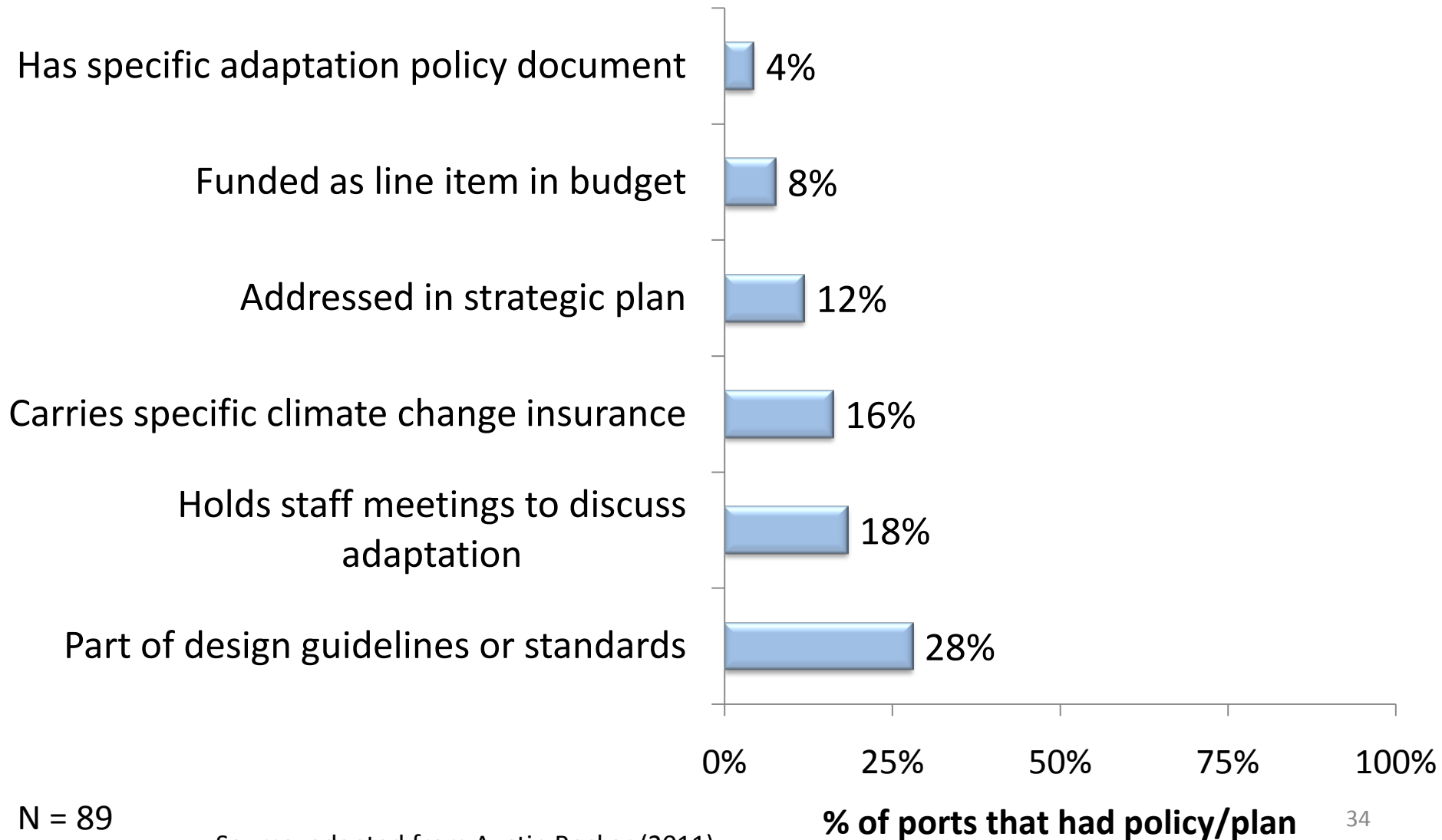


Source: Austin Becker survey (2011)

Unsuitable Design Standards for Climate Change



Ports Have Few Formal Plans That Address Adaptation



Toward Resilient Port Systems

- Robust port and connecting infrastructure can withstand shock of extreme storm events and other disruptions
- Redundancy allows for substitutions and alternate choices
- Capacity to mobilize resources to handle an emergency
- Quick resumption of normal conditions
- Minimal social disruption, economic losses, and environmental harm

Summary

- What happens to the coast happens to the nation
- Ports are crucial nodes
- Think:
 - Change, disruption, and long-term horizons
 - Beyond the “port island”
 - Collaboration with stakeholders
- Careful forward thinking and preparedness needed to minimize risk and assure continued operability and profit



Invitation for CMANNC to Join NCAnet



NCAnet – A Network of Partners

<http://ncanet.usgcrp.gov/>

Why join >100 other organizations?

- Stay up to date on the NCA
- Be the first to receive information
- Share your information needs and help shape future assessment activities
- Bring NCA information to your partners
- Collaborate with partners on solutions

THANK YOU!!!



Source: chesapeakebaynet.org

Contact: **Susi Moser, Ph.D.**

Email – promundi@susannemoser.com

Web: – www.susannemoser.com