Implications of the National Climate Assessment

March 14, 2013

Moderator: David Hales
President, Second Nature
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• Contact:
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2009 Revenue $18.1 billion
95,000 employees

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Barbara L. Bowen, PhD, Principal & Knowledge Architect, has over 25 years of professional experience & leadership in the application of research-based cognitive technologies to enhance learning & performance.

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David Hales, President and CEO of Second Nature, is a member of the National Climate Assessment and Development Advisory Committee (NCADAC), established to oversee the development of the report. Previously, he led College of the Atlantic to become the first institution of higher education in the United States to be a “NetZero” emitter of greenhouse gases and has held numerous positions promoting sustainability nationally and internationally.
Session Agenda

• Introduction to the Panel: **David Hales**
• Panel Presentations
  ➢ **Lynne Carter, Louisiana State University**: The Southeast and the Caribbean Region
  ➢ **Mark Shafer, Oklahoma Climatological Survey**: Managing for Change Across the Great Plains
  ➢ **Lynne Carter, Louisiana State University**: Adaptation in the United States
  ➢ **Sue Tierney, Analysis Group**: Energy Supply and Use
• Panel Discussion Questions
• Audience Questions: *Send your questions through the chat box*
• Summary Points
• Thank you!

Please fill out the audience survey
Mark Shafer is Director of Climate Services with the Oklahoma Climatological Survey and co-Director of the Southern Climate Impacts Planning Program. His work focuses on place-based applications of climate and weather information to improve community preparedness to a range of natural hazards.

Sue Tierney a Managing Principal at Analysis Group, is an expert on energy economics, regulation and policy. For 18 years, she has consulted to businesses, government, tribes, environmental groups, and other organizations on energy markets, economic and environmental regulation and strategy, and energy projects, especially on issues relating to electricity and natural gas.
Draft 2013 National Climate Assessment
Possible Implications for Managers and Decision-Makers

Second Nature, and Security and Sustainability Forum
March 14, 2013
National Climate Assessment:
GCRA (1990), Section 106

…not less frequently than every 4 years, the Council… shall prepare… an assessment which –

• integrates, evaluates, and interprets the findings of the Program (USGCRP) and discusses the scientific uncertainties associated with such findings;

• analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and

• analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.
The “New” National Climate Assessment

Goal

• Enhance the ability of the United States to anticipate, mitigate, and adapt to changes in the global environment.

Vision

• Advance an inclusive, broad-based, and sustained process for assessing and communicating scientific knowledge of the impacts, risks, and vulnerabilities associated with a changing global climate in support of decision-making across the United States.
Process to Date

• First “request for information”: 250+ technical inputs from 100+ individuals and teams, including:
  – New regional climate histories and projections for each region
  – New sea level rise scenarios
  – In-depth foundational assessments for each region and most sectors

• Author teams delivered their draft chapters to the NCADAC

• Draft report released January 11, Public comment period opened January 14

Island Press is publishing most of the regional technical inputs over the next few months:
http://www.cakex.org/NCAreports
(Pacific Islands and Coasts currently available, Southwest expected in February 2013)

Most of the federal agency-sponsored reports are available from
Third NCA Report Process

Federal agencies, universities, NCAnet members, and others

- **Technical Input Teams**
- **Chapter Author Teams**
- **NCADAC**
- **Public and Expert Review**
- **Agency & White House Review**

- Technical Inputs (March 1, 2012)
- Chapters (June 1, 2012)
- Draft Report (Late 2012)
- Revised Report (Fall 2013)
- Third NCA Report (Early 2014)

January 14 – April 12, 2013
Products and Outcomes

- Delivery of the Third NCA Report via an e-book, 400 pages, and a 50 page printed synthesis document
- A defensible, transparent, well-documented product
- First stage of the Global Change Information System for USGCRP – electronic access to all findings and data
- An information foundation for strong communications products and processes that are useful to a variety of audiences, including Congress, local regional and state decision-makers, etc.
CLIMATE ISSUE

Don't look at it directly.

Watch out for the shadow of your doubt.
RESEARCH CONCLUDES:

WE ARE DESTROYING EARTH.

COULD YOU KINDLY REPHRASE THAT IN EQUIVOCAL, INACCURATE, VAGUE, SELF-SERVING AND ROUNDABOUT TERMS THAT WE CAN ALL UNDERSTAND?
Sectors

• Water resources
• Energy supply and use
• Transportation
• Agriculture
• Forestry
• Ecosystems and biodiversity
• Human health
Sectoral Cross-Cuts

- Water, energy, and land use
- Urban/infrastructure/vulnerability
- Impacts of climate change on tribal, indigenous, and native lands and resources
- Land use and land cover change
- Rural communities and development
- Impacts on biogeochemical cycles
Major focus on engagement and communications
NCAnet: Partners in Assessment

- A network of organizations that extend the NCA process and products
- Building long-term capacity to conduct and use assessments
- Cultivating partnerships with organizations that will participate in the sustained assessment process

60+ organizations so far
http://ncanet.usgcrp.gov
Draft Review

• Draft of NCA released for review Jan 14, 2013
• Comments can be submitted by the public, agencies and individual agency employees at
  http://ncadac.globalchange.gov
• All comments will be responded to, both comments and responses will be publicly available
• Although commenters must identify themselves in the online form, their identity will not be provided to the authors or review editors during the response period
• Only comments submitted via the official online comment forms will be accepted
How to Provide Comments

• To provide input on the Third NCA Draft Report go to:

http://ncadac.globalchange.gov
The Southeast and Caribbean Region

National Climate Assessment
(Public Draft 2013)

Excerpts and Briefing – March 14, 2013
The Writing Team

Convening Lead Authors
• Lynne M. Carter, Louisiana State University (climate issues) (LA for Adaptation, FAC for NCA)
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Lead Authors
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• Paul J. Schramm, Ctrs for Disease Control and Prevention (human health)
• David Wear, U.S. Forest Service (forests)

Thanks to those who contributed documents: All 57 were reviewed
The SE and Caribbean Region

- Geographies: Appalachian Mts to coastal plains
- 80 million residents, hundreds of million visitors
- Includes 1 most populous metropolitan area in US (Miami), 4 of 10 fastest growing areas, 3 coastal – Palm Coast, Cape Coral/Ft Meyers, Fl and Myrtle Beach area, SC.
- Major producer of seafood; coal; crude oil; natural gas
- Highest energy user of all NCA regions

Plus Puerto Rico and the Virgin Islands
Climate Observed

- Climate influenced by many factors; temps decrease north and into mts; precip decreases away from coasts
- SE: cycled between warm and cool over past century
- Warming since 1970 (a cool period) = ~ 2°
- Increasing days above 95°, nights above 75°
- Decreasing numbers of extremely cold days since 1970
- Daily and 5-day rainfall intensities have increased
- Summers either increasingly dry or extremely wet
- Number of Atlantic-basin hurricanes has increased slightly during the last 130 years, and Category 4 and 5 hurricanes have increased since the 1970s
NOAA Billion Dollar Weather/Climate Disasters

MAP OF THE UNITED STATES SHOWING THE NUMBER OF EVENTS 1980-2011

- States shaded in red indicate those with the most billion dollar weather/climate disasters.
- States shaded in yellow indicate those with the least billion dollar weather/climate disasters.

NOAA/NCDC
Climate Projected

- Temperatures expected to increase by 2100 – interior up to $+10^\circ$; 2-4$^\circ$ for Caribbean; regional average $+2-6^\circ$
- Impact $+95^\circ$ days
- Precip projections less certain – high emissions 2100 could be nearly 10% reduction in the far southern and western parts region – with most reduction in summer – to $\sim 5\%$ increases in the northeastern part of the region
- Likely fewer tropical storms globally but stronger in force – more category 4 & 5 storms
Three Key Messages

• **Sea level rise** poses widespread and continuing threats to both natural and built environments, as well as the regional economy.

• **Rising temperatures** and the associated increase in frequency, intensity, and duration of extreme heat events will affect public health, natural and built environments, energy, agriculture, and forestry.

• **Decreased water availability**, exacerbated by population growth and land-use change, will continue to increase competition for water and impact the region's economy and unique ecosystems.
Sea level Rise

Sea level rise poses widespread and continuing threats to both natural and built environments, as well as the regional economy.
Sea Level Rise

Examples of Vulnerability:

• Susceptibility to change and natural ability to adapt = vulnerability index below (USGS)

• Cities, roads, rail, ports, airports, oil and gas facilities and water supply potentially vulnerable

• Implications for non-coastal cities w/ migrants – 200,000 to Houston- 42% will try to remain

• Ecosystems – salt water intrusion (rice, fresh water); fresh water forests retreating, mangroves expanding landward, marshes to open water

Actions:

• Raising roadbeds – NC, LA

• SLR in planning new facilities; diversifying water sources

• SE FL Regional Compact
Rising Temperatures

Rising temperatures and the associated increase in frequency, intensity, and duration of extreme heat events will affect public health, natural and built environments, energy, agriculture, and forestry.
Extreme heat

- Human Health impacts: direct and indirect – ozone increases in 19 largest urban areas in the region = increased hospital emissions and deaths, expanded mosquito regions and diseases, increases in harmful algal blooms with warmer water
- Ecosystems: coral reefs susceptible to warmer water, invasive plants and pests, reduced crop productivity
- Heat stress on livestock – warmer summers
- Wildfires - temps increased frequency, intensity and size, drought correlations
- Forest disturbances - insects, pathogens
- Power - stress generation capacity & use/demand increases
Water availability

Decreased water availability, exacerbated by population growth and land-use change, will continue to increase competition for water and impact the region's economy and unique ecosystems.
Water Availability/Drought

- Already large populations and economies (ag, energy, tourism) dependent on water
- Abundant water but also already experiencing droughts/water conflicts e.g. Atlanta region 2007, Puerto Rico 1997-98. Drought a frequent climate hazard in Caribbean producing economic losses/anxiety.
- Projected increases in population, converting rural, forests, wetlands to residential, commercial, industrial, and agriculture zones; increased transpiration, all expected to intensify demands.
- Potential for reduced fresh water: salt water intrusion, porous aquifers, climate change scenarios for Caribbean, e.g., all show water stress
- Action options include: water recycling as Clayton County, GA, reservoir expansion, conservation/efficiency, more inland well fields
Managing for Change Across the Great Plains

Mark Shafer, University of Oklahoma
Dennis Ojima, Colorado State University

Implications of the National Climate Assessment
14 March 2013
Great Plains Author Team

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Lead Authors
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• Sascha Petersen, Adaptation International
• Bridget Scanlon, University of Texas
• Kathleen Sherman, Colorado State University
The Great Plains

- ~500,000 sq. miles
- Agriculture, Livestock and Energy
- Semi-arid environment
- Growing urban, declining rural populations
Significant Climate Challenges

1) resolving increasing competition among land, water, and energy resources
2) developing and maintaining sustainable agricultural systems
3) conserving vibrant and diverse ecological systems
4) enhancing the livelihoods of the region’s people.
Temperature and Precipitation Distribution in the Great Plains

Annual Temperature (°F):
- <35
- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60-65
- 65-70
- >70

Annual Precipitation (inches):
- <10
- 10-17
- 17-24
- 24-31
- 31-38
- 38-45
- 45-52
- 52-59
- >59
A Range of Extremes

Photo: Kevin Burns

Photo: Von Castor & Fox23 Tulsa

Photo: NWS-Tulsa
Expected Climate Changes

• Wetter in the north, drier in the south
• More frequent and intense droughts, severe rainfall events, heat waves
  – Driven by higher evapotranspiration rates
• Growing season extended average 24 days by mid-century
  – More over-wintering pests
Changes in extremes
Change in Dry Days

[Map showing change in dry days under lower emissions (B1) and higher emissions (A2). The map indicates variations in the number of dry days across different regions, with color coding representing the number of days from -8 to 6.]

U.S. Global Change Research Program
National Climate Assessment
Growing season anomalies shown as number of days per year. Length of the growing season is defined as the period between the last occurrence of 32°F in the spring and first occurrence of 32°F in the fall. Red line is a linear fit. Based on data from the National Climatic Data Center for the cooperative observer network and updated from Kunkel et al. (2004).
Challenges to Irrigation

- Little recharge in southern part of High Plains Aquifer
- Irrigation becoming more costly
- Higher evaporation rates deplete surface water supplies
- More competition for water
Dealing with Regional Climate Changes across Ecosystem Management Sectors

• Social-ecological systems are interwoven through networks of biophysical, socio-economic, and ecosystem processes

• Convergent demands on ecosystem services and changing livelihood conditions across the West and the world calls for innovative approaches to deal with critical ecosystem services, especially (but not exclusively) WATER
Key Message #1

Rising temperatures are leading to increased demand for water and energy. In parts of the region, this will constrain development, stress natural resources, and increase competition for water among communities, agriculture, energy production, and ecological needs.
Causes of Concerns

• Energy production affects and is affected by water availability & habitats
• Growing population in Texas adding to demands
• Warmer summers increase evapotranspiration (water loss), lessening supplies
• Most apparent in south, but issues throughout region
Key Message #2

Changes to crop growth cycles due to warming winters and alterations in the timing and magnitude of rainfall events are already observed; as these trends continue, they will require new agriculture and livestock management practices.
Causes of Concerns

• Challenges of the High Plains Aquifer
  – Conversion to dryland farming
• Increased precipitation and warmer winters in North will benefit production
• Shortened dormancy period for winter wheat
  – Livestock grazing, spring freezes
• Changes in pest management
• Erosion and nutrient runoff
Key Message #3

Landscape fragmentation is increasing, for example, in the context of energy development activities in the northern Great Plains. A highly fragmented landscape will hinder adaptation of species when climate change alters habitat composition and timing of plant development cycles.
Causes of Concerns

• Energy production, urban development, fewer conservation easements
  – These are concerns independent of climate change
• Limited ability to migrate
• Idle lands susceptible to non-native invasion
• Changes in timing of flowering can disrupt ecosystem balances
• Increased wildfire risk
Example: Sage Grouse Decline

• Candidate for Endangered Species designation
• 7-19% decline in sage grouse populations depending on development scenario
• Red & Orange = energy development areas
• Blue = sage grouse habitat
Key Message #4

Communities that are already the most vulnerable to weather and climate extremes will be stressed even further by more frequent extreme events occurring within an already highly variable climate system.
Causes of Concerns

• Geographically remote communities, limited services, growing elderly populations, language barriers
• Susceptibility to heat waves
• Disappearance of culturally-important plant and animal species
• Language barriers may impede ability to plan for and adapt
Key Message #5

The magnitude of expected changes will exceed those experienced in the last century. Existing adaptation and planning efforts are inadequate to respond to these projected impacts.
Causes of Concerns

• An integrated system: changes in one part cause changes in others
• Some changes already underway
  – Temperature & precipitation patterns
  – Plant development cycles
• Competition for water
• Increased drought, flood & heat waves
• Magnitude of expected changes greater than current planning resources
Summer 2011: A Sign of the Future?

- Exceptional drought in southern plains
- Hottest summer on record
- Water loss rates twice the average
- Wettest spring in northern plains
- Record rainfall & flooding
Example: Adapting to Drought

• Drought forced liquidation of large herds, especially in 2011
• Many sold to slaughterhouses or relocated to other pastures
• Ranchers and Farmers are eternal optimists
  – Opportunity to diversify: at least one rancher in Texas is now keeping a second herd in Montana
  – Opportunity to improve genetic stock as herds are rebuilt
National Climate Assessment
(Public Draft 2013)

Adaptation in the United States

Excerpts and Briefing - March 14, 2013
Adaptation in the United States

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Laura Verduzco, Chevron Corporation
Emily Wasley, UCAR

Thank you to those who contributed the 130 technical papers – all were reviewed
The Context

- Climate change affects human health, natural ecosystems, built environments, and existing social, institutional, and legal arrangements.
- Uncertainties about future socioeconomic conditions as well as future changes in climate can make it difficult to make some adaptation decisions now.
- However, the pace and magnitude of projected change emphasize the need for being prepared for a wide range and intensity of climate impacts.
- Because of the influence of human activities, the past climate is no longer a sufficient indicator of future conditions.
- Adaptation actions can be implemented reactively, after changes in climate occur, or proactively, to prepare for projected changes.

...Given that some uncertainties about how climate will change cannot be eliminated, development, refinement, and deployment of tools and approaches that enable decision-making and increase flexibility and robustness to climate change are still needed.
Key Message One

Substantial adaptation planning is occurring in the public and private sectors and at all levels of government, however, few measures have been implemented and those that have appear to be incremental changes.
“... Federal agencies are all required to plan for adaptation. Actions include coordinated efforts at the White House, regional and cross-sector efforts, agency-specific adaptation plans, as well as support for local-level adaptation planning and action....”

Examples of Federal Adaptation Actions

<table>
<thead>
<tr>
<th>Agency</th>
<th>Component</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Federal Agencies</td>
<td>Developing Adaptation Plans</td>
<td>The 2012 Strategic Sustainability Performance Plans for 50+ Federal agencies contain specific actions on adaptation. Agencies are required to evaluate climate risks and vulnerabilities to manage both short and long term effects on missions and operations.</td>
<td></td>
</tr>
<tr>
<td>Department of Health and Human Services (HHS)</td>
<td>Centers for Disease Control and Prevention (CDC)</td>
<td>Climate-Ready States and Cities Initiative</td>
<td>Through their first climate change cooperative agreements in 2010, CDC awarded $5.25 million to ten state and local health departments to assess risk and develop programs to address climate change related challenges.</td>
</tr>
<tr>
<td>Department of Agriculture (USDA)</td>
<td>Integrating climate change objectives into plans and networks.</td>
<td>USDA is using existing networks such as the Cooperative Extension Service, the Natural Resource Conservation Districts, and the Forest Service’s Climate Change Resource Center to provide climate services to rural and agricultural stakeholders.</td>
<td></td>
</tr>
<tr>
<td>EPA</td>
<td>Developed Climate Ready Estuaries and Climate Ready Water Utilities Working Group. Developed a draft EPA water program adaptation strategy.</td>
<td>The Climate Ready Estuaries program works with coastal managers to: (1) assess vulnerabilities; (2) develop and implement adaptation strategies; (3) engage stakeholders; and (4) share lessons learned. The Climate Ready Water Utility Initiative provides resources and tools to assist the water sector in adapting to climate change. The Draft National Water Program Strategy: Response to Climate Change addresses climate change impacts on water resources and EPA’s water programs.</td>
<td></td>
</tr>
<tr>
<td>USDA</td>
<td>Forest Service</td>
<td>Developed a National Roadmap for Responding to Climate Change and a Guidebook for Developing Adaptation Options, among many resources</td>
<td>The National Roadmap was developed in 2010 to identify short- and long-term actions to reduce climate change risks to the nation’s forests and grasslands. The Guidebook developed in 2011 builds on this previous work and provides science-based strategic and tactical approaches to adaptation. Other resources are available on the Forest Service website.</td>
</tr>
<tr>
<td>Department of Commerce (DOC)</td>
<td>NOAA</td>
<td>Supports research teams and local communities on adaptation-related issues and develop tools and resources.</td>
<td>Supports research teams such as Regional Integrated Sciences and Assessments (RISAs), which are partnerships with universities working collaboratively to inform resource management, planning, and policy. Established six regional climate centers (fRCCs) to better assess and deliver regionally-focused climate science and services. Developed the Digital Coast partnership.</td>
</tr>
</tbody>
</table>

- Executive Order (EO) 13514 requiring Federal agencies to develop recommendations for strengthening policies and programs to adapt to the impacts of climate change.
- The creation of an Interagency Climate Change Adaptation Task Force (ICCATF) that led to the development of national principles for adaptation and is leading to crosscutting and government-wide adaptation policies.

This list contains selected examples of agency work on adaptation and should not be considered all-inclusive. Material provided in table is derived from Agency websites.
“States have become important actors in national climate-related efforts, often through the creation of policies and programs that incentivize or inhibit adaptation at other governance scales, through regulation, and by serving as laboratories for innovation. ....”

Although many of these actions are not specifically designed to address climate change, they often include climate adaptation components.

Examples of State Adaptation Actions

<table>
<thead>
<tr>
<th>State</th>
<th>Adaptation Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>Alaska Climate Change Impact Mitigation Program provides funds for hazard impact assessments to evaluate climate change-related impacts, such as coastal erosion and thawing permafrost (Immediate Action Workgroup 2008).</td>
</tr>
<tr>
<td>California</td>
<td>Building standards mandating energy and water efficiency savings, advancing both adaptation and mitigation; State Adaptation Plan calls for 20% reduction in per capita water use (EPA 2012).</td>
</tr>
<tr>
<td>Florida</td>
<td>Law supporting low water use landscaping techniques (Salkin 2000).</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Water code that calls for integrated management, preservation, and enhancement of natural systems (Marra 2012).</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Action Plan to Respond to Climate Change in Kentucky: A Strategy of Resilience, which identifies six goals to protect ecosystems and species in a changing climate.</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Comprehensive Master Plan for a Sustainable Coast 2012 includes both protection and restoration activities addressing land loss from sea level rise, subsidence, and other factors over the next 50 years (State of Louisiana 2012).</td>
</tr>
<tr>
<td>Maine</td>
<td>The Maine Sand Dune Rules require that structures greater than 2,500 square feet be set back at a distance that is calculated based on the future shoreline position and considering two feet of sea level rise over the next 100 years (Grannis 2011).</td>
</tr>
</tbody>
</table>

Figure 28.1 Status of State Climate Adaptation Plans. (Figure redrawn from C2ES (Center for Climate and Energy Solutions) 2012a)
Most adaptation efforts to date have occurred at local and regional levels...

- Primary mechanisms that local governments are using to prepare for climate change include: **land-use planning**; **provisions to protect infrastructure and ecosystems**; **regulations** related to the design and construction of buildings, roads, and bridges; and **emergency preparation, response, and recovery**.

- In a recent survey of 298 U.S. local governments, 59% indicated they are engaged in some form of adaptation planning.

<table>
<thead>
<tr>
<th>Local or Regional Government</th>
<th>Adaptation Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Beach, FL</td>
<td>Collaboration with the Indian River Lagoon National Estuary Program led to the incorporation of sea level rise projections and policies into the city’s comprehensive growth management plan (Gregg 2011).</td>
</tr>
<tr>
<td>Portland, OR</td>
<td>Updated the city code to require on-site stormwater management for new development, and re-development and provides a downspout disconnection program to help promote onsite stormwater management (EPA 2010a).</td>
</tr>
<tr>
<td>Lewes, DE</td>
<td>In partnership with Delaware Sea Grant, ICLEI-Local Governments for Sustainability, the University of Delaware, and state and regional partners, the City of Lewes undertook a stakeholder-driven process to understand how climate adaptation could be integrated into the hazard mitigation planning process. Recommendations for integration and operational changes were adopted by the City Council and are currently being implemented (City of Lewes, 2011).</td>
</tr>
<tr>
<td>Groton, CT</td>
<td>Partnered with Federal, state, regional, local, nongovernmental, and academic partners through the EPA’s Climate Ready Estuaries program to assess vulnerability to and devise solutions for sea level rise (Stults 2011).</td>
</tr>
<tr>
<td>San Diego Bay, CA</td>
<td>Five municipalities partnered with the port, the airport, and more than 30 organizations with direct interests in the future of the Bay to develop the San Diego Bay Sea Level Rise Adaptation Strategy. The strategy identified key vulnerabilities for the Bay and adaptation actions that can be taken by individual agencies, as well as through regional collaboration (Solecki; Rosenzweig 2012).</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>Through a number of development projects, the city has added 55 acres of permeable surfaces since 2008 and has more than four million square feet of green roofs planned or completed (City of Chicago 2008).</td>
</tr>
<tr>
<td>King County, WA</td>
<td>Created King County Flood Control District in 2007 to address increased impacts from flooding through activities such as maintaining and repairing levees and revetments, acquiring repetitive loss properties, and improving countywide flood warnings (Wolf, 2009).</td>
</tr>
<tr>
<td>New York City, NY</td>
<td>Through a partnership with the Federal Emergency Management Agency (FEMA), the city is updating FEMA Flood Insurance Rate Maps based on more precise elevation data. The new maps will help stakeholders better understand their current and future flood risks and allow the city to more effectively plan for climate change (City of New York, 2012).</td>
</tr>
<tr>
<td>Southeast Florida Climate Compact</td>
<td>Joint commitment among Broward, Miami-Dade, Palm Beach and Monroe Counties to partner in reducing greenhouse gas emissions and adapting to climate impacts (Southeast Florida Compact Counties 2011).</td>
</tr>
</tbody>
</table>
“Many non-governmental entities have been significant actors in the national effort to prepare for climate change…”

...by providing assistance that includes planning guidance, implementation tools, contextualized climate information, best practice exchange, and help with bridging the science-policy divide to a wide-array of stakeholders.

<table>
<thead>
<tr>
<th>Table 28.4: Examples of Non-governmental Adaptation Efforts and Services</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Types of Adaptation Efforts and Services</strong></td>
</tr>
<tr>
<td>Adaptation planning assistance, including creation of guides, tools, and templates</td>
</tr>
<tr>
<td>Networking and best practice exchange</td>
</tr>
<tr>
<td>Climate information providers</td>
</tr>
<tr>
<td>Policy, legal, and institutional support</td>
</tr>
<tr>
<td>Aggregation of adaptation-pertinent information</td>
</tr>
</tbody>
</table>
A growing number of companies are beginning to actively address risks from climate change.

Table 28.5: Examples of Private Sector Actions to Adapt to Climate Risks Based on Responses to Carbon Disclosure Project

<table>
<thead>
<tr>
<th>Company</th>
<th>Sector</th>
<th>Climate Risk</th>
<th>Examples of Actions Undertaken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coca-Cola Company</td>
<td>Consumer</td>
<td>Changes in physical climate parameters; Changes in other climate-related developments</td>
<td>Coca-Cola is working around the world to replenish the water used in finished beverages by participating in locally relevant water projects that support communities and nature. Since 2005, the Coca-Cola system has engaged in more than 320 projects in 86 countries. The range of community projects includes watershed protection; expanding community drinking water and sanitation access; water for productive use, such as agricultural water efficiency, and education and awareness programs. (<a href="http://www.thecocacolacompany.com/citizenship/conservation_partnership.html">http://www.thecocacolacompany.com/citizenship/conservation_partnership.html</a>)</td>
</tr>
<tr>
<td>ConAgra Foods, Inc.</td>
<td>Consumer</td>
<td>Company experienced weather-related sourcing challenges, such as delayed tomato harvesting due to unseasonably cool weather, and difficulty sourcing other vegetables due to above normal precipitation.</td>
<td>As part of its business continuity planning, ConAgra Foods has analyzed its supply risk to develop strategic partnerships with suppliers, minimize sole-sourced ingredients, and identify alternate suppliers and contract manufacturers to minimize production disruptions in the instance of an unexpected disruption in supply. (<a href="http://company.conagrafoods.com/phoenix_zhtml?c=202310&amp;p=Policies_Environment">http://company.conagrafoods.com/phoenix_zhtml?c=202310&amp;p=Policies_Environment</a>)</td>
</tr>
<tr>
<td>Constellation Brands</td>
<td>Consumer</td>
<td>Changes in physical climate parameters; Changes in other climate-related developments</td>
<td>Constellation has already taken adaptation actions, particularly in California where water availability is an issue, to manage or adapt to these risks. Constellation is working with numerous organizations to help fund industry-based research to determine potential climate change impacts on vineyard production.</td>
</tr>
</tbody>
</table>
Key Message Two

Barriers to implementation of adaptation action include lack of funding, policy and legal impediments, and difficulty in anticipating climate-related changes at local scales.
Key Message Three

There is no "one-size fits all" adaptation, but there are similarities in approaches across regions and sectors. Sharing best practices, learning by doing, and iterative and collaborative processes including stakeholder involvement, can help support progress.
Vulnerability to climate change is exacerbated by other stresses such as pollution and habitat fragmentation. Adaptation to multiple stresses requires assessment of the composite threats as well as tradeoffs amongst costs, benefits, and risks of available options.

Climate change adaptation actions often fulfill other societal goals, such as sustainable development, disaster risk reduction, or improvements in quality of life, and can therefore be incorporated into existing decision-making processes.
The effectiveness of climate change adaptation has seldom been evaluated, because actions have only recently been initiated, and comprehensive evaluation metrics do not yet exist.

Next Steps:

- Enabling research and development to advance adaptation across scales, sectors, and disciplines.
- Research on the kinds of information users desire as well as how to deliver that information in contextually appropriate ways.
- Research on decision-making in light of uncertainty about climate change and other considerations will be equally important.
- Research on costs and benefits of adaptation; adaptation and mitigation interactions; critical adaptation thresholds; and adaptation to extremes.
Case Studies

National Integrated Drought Information System (NIDIS)
- Proposed by WGA
- Provides real-time nationwide data on state of drought
  - Proved very useful in 2012

Graphic from final report
NOT NCA chapter

Cape Cod Transportation study
Combined Mitigation and Adaptation goals to reduce GHG and build resilience to present and future changes in climate with wise development options.

Graphic from final report
NOT NCA chapter
Adaptation is a necessity because climate is changing and the change will likely accelerate.

Adaptation is beginning to be addressed at all levels of government, by NGOs, and the private sector.

- To date there has been a lot of planning, but not a lot of implementation.

Barriers to adaptation include funding, policies and institutions, and challenges in interpreting information.

Adaptation will likely vary from place to place.

Vulnerability to climate change is often exacerbated by other stresses.

- Many adaptations address multiple goals.

Evaluation and research is needed.
Key Findings of
The National Climate Assessment:
Energy Supply and Use (Draft)

Sue Tierney, Analysis Group
Co-lead Author: Energy Supply and Use Chapter

National Climate Assessment
U.S. Global Change Research Program

http://assessment.globalchange.gov
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Key Findings – Energy Chapter

1. Extreme weather events are affecting energy production and delivery facilities.

2. Higher summer temperatures will increase electricity use.

3. Both episodic and long-lasting changes in water availability will constrain different forms of energy.

4. In the longer term, sea level rise will affect coastal facilities and infrastructure on which many energy systems, markets, and consumers depend.

5. As new investments in energy technologies occur, future energy systems will differ from today’s in uncertain ways. Depending on the character of changes in the energy mix, climate change will introduce new risks as well as opportunities.
Finding #1: Disruptions from Extreme Weather Events

• Extreme weather events are affecting energy production and delivery facilities
  – causing supply disruptions of varying lengths and magnitudes and affecting other infrastructure that depends on energy supply.

• The frequency and intensity of extreme weather events are expected to increase.
Disruptions from Extreme Weather Events

- Much of the US energy infrastructure is vulnerable to extreme weather events.
- Climate change has begun to affect the frequency, intensity, and length of many extreme weather events.
- Extreme weather events affecting energy infrastructure in one place can lead to supply consequences elsewhere (including in other key systems).
Example:

Paths of Hurricanes Katrina and Rita Relative to Energy Production Facilities

Source: GAO analysis of data provided by the National Weather Service and the Minerals Management Service.
Effects of Extreme Weather Events: Other examples

- Various aspects of climate change will affect energy systems. For example:

  - **Wildfires** are projected to affect extensive portions of California’s electricity transmission grid.

  - **Extreme surge events** at high tides are expected to increase, raising the risk of inundating energy facilities such as power plants, refineries and pipelines.

  - More **intense rainstorms**, both observed and projected, can lead to river flooding that degrades or washes out nearby railroads and roadbeds.
Finding #2:
Climate Change and Seasonal Energy Demand

- Higher summer temperatures will increase electricity use, causing higher summer peak loads.
- Warmer winters will decrease energy demands for heating.
- Net energy use is projected to increase.
Climate Change and Seasonal Energy Demand

• The rate of temperature change has increased:
  – EIA has begun to use 10-year average weather data instead of 30-year data in order to estimate energy demands for heating and cooling purposes
The amount of energy needed to cool (or warm) buildings is proportional to cooling (or heating) degree days. The figure shows increases in “cooling degree days,” which result in increased air conditioning use, and decreases in “heating degree days,” meaning less energy required to heat buildings in winter, compared to the average for 1970-2000. As shown, the increase in cooling needs is greater than the decrease in heating needs (Source: National Climate Data Center, NOAA, EIA (2012)).
Increasing Numbers of Cooling Degree Days

The NCA National Climate Outlook projects continued increases in cooling degree days (and decreases in heating degree days) over the next several decades. The higher the number of cooling degree days, the more people tend to use air conditioning.

These maps show projected average changes in cooling degree days compared to the baseline period (1971 to 2000) for 2 periods (2021 to 2050 and 2070 to 2099), assuming climate change associated with continued increases in emissions and significant reductions in emissions of heat-trapping gases.

The projections show significant regional variations, with the greatest increases in the southern U.S. By the end of this century, the increases in cooling degree days will be more pronounced for the higher emissions (A2) scenario. Also, projections suggest continued population shifts toward areas that require air conditioning in the summer, thereby increasing the impact of temperature changes on increased energy demand.

The NCA National Climate Outlook projects continued increases in cooling degree days (and decreases in heating degree days) over the next several decades. The higher the number of cooling degree days, the more people tend to use air conditioning.
# Infrastructure Affected

Changing Energy Use for Heating and Cooling Will Vary by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Electricity Use</th>
<th>Natural Gas (Heating)</th>
</tr>
</thead>
</table>
| Physical Impacts - High Likelihood | Warmer and longer summers  
Number of Additional Extreme Days (> 95°F) and % Increase in Cooling Degree Days in 2041-2070 above 1971-2000 Level | Warmer winters  
Number of Fewer Extreme (< 10°F) Cold Days and % Decrease in Heating Degree Days in 2041-2070 below 1971-2000 Level |
| Northeast       | + 10 days, +77%                                                                | - 12 days, -17%                                                                     |
| Southeast       | +23 days, 43%                                                                  | - 2 days, -19%                                                                      |
| Midwest         | +33 days, +64%                                                                 | - 14 days, -15%                                                                     |
| Great Plains    | +22 days, +37%                                                                 | - 4 days, -18%                                                                      |
| Southwest       | +20 days, +44%                                                                 | - 3 days, -20%                                                                      |
| Northwest       | +5 days, +89%                                                                  | - 7 days, -15%                                                                      |
| Alaska          | Assumed Neutral - Not modeled                                                  | Assumed - Not modeled                                                                |
| Pacific Islands | Assumed - Not modeled                                                          | Assumed Neutral – Not modeled                                                       |

Red cells denote negative impacts, Green cells denote positive impacts
Climate change affects precipitation patterns as well as temperatures. The maps show projected changes in average precipitation by season (in %) for 2041–2070 compared to a base period of 1971–2000, assuming heat-trapping emissions continue to rise (A2 scenario). Note significantly drier conditions in the Southwest spring and Northwest summer, as well as significantly more precipitation (some of which could fall as snow) projected for northern states in winter and spring. (Source: NARCCAP; National Climatic Data Center, National Oceanic and Atmospheric Administration, 2012).
Finding #3 –
Both episodic and long-lasting changes in water availability will constrain different forms of energy production.
Less Water for Energy Production

For example:

• **Reduced availability of water for cooling or for hydropower** will continue to constrain power production at existing facilities and permitting of new power plants.

• **Expected reductions in snowpack** in parts of the West will reduce hydropower production.

• EPRI’s scenario-based technical projections of 2030 water demand find that **one-quarter of existing power generation facilities nationwide are in counties that face some type of water sustainability**.

• **Many regions face water sustainability concerns**, with the most significant water-related stresses in the Southeast, Southwest, and Great Plains regions.
Finding #4 – Sea Level Rise and Infrastructure Damage

• In the longer term, sea level rise will affect coastal facilities and infrastructure on which many energy systems, markets, and consumers depend.
Sea level rise and energy infrastructure

- Significant portions of US energy production and delivery infrastructure are in low-lying coastal areas.
  - Oil and natural gas production and delivery facilities, refineries, power plants, and transmission lines.

- Global sea level has risen by about 8” since reliable record keeping began in 1880, affecting countries throughout the world, including the U.S.

- The rate of rise increased in recent decades and is not expected to slow.
Sea level rise and energy infrastructure

- Rising sea levels, combined with normal and potentially more intense coastal storms and local land subsidence, threaten coastal energy equipment as a result of inundation, flooding, or erosion.
  - In particular, sea level rise and coastal storms pose a danger to the dense network of OCS marine and coastal facilities in the central Gulf Coast region.
  - Many of California’s power plants are at risk from sea level rise and the more extensive coastal storm flooding that results, especially in the low-lying San Francisco Bay area.
  - Power plants and energy infrastructure in the coastal areas of U.S. regions face similar risks.
Finding #5:  Future Energy Systems

- As new investments in energy technologies occur, future energy systems will differ from today’s in uncertain ways.
- Depending on the character of changes in the energy mix, climate change will introduce new risks as well as opportunities.
A very uncertain energy future

• Today’s energy systems vary significantly by region, with differences in climate-related impacts also introducing considerable variation by locale.
  – Most vulnerabilities and risks for energy supply and use are unique to local situations, but others are national in scope.
  • For example, biofuels production in three regions (Midwest, Great Plains and Southwest) could be impacted by the projected decrease in precipitation during the critical growing season in the summer months.
A very uncertain energy future

- One certainty about energy systems in the future is that they will be different than today’s, but in ways not yet known.
  - Many uncertainties – financial, economic, regulatory, technological, etc. – will affect private and public consumption and investment decisions on energy fuels, infrastructure, and systems.
  - Energy systems will evolve over time, depending upon myriad choices made by countless decision makers responding to changing conditions in markets, technologies, policies, consumer preferences, and climate.
  - A key challenge to understanding the nature and intensity of climate impacts on future energy systems is the amount of uncertainty regarding future choices about energy technologies and their deployment.
A very uncertain energy future

- One certainty about energy systems in the future is that they will be different than today’s, but in ways not yet known.
  - An evolving energy system is also an opportunity to develop an energy system that is less vulnerable to climate change.
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Audience Questions
Summary Points

• Rising temperatures will affect public health, natural resource availability, infrastructure, energy, agriculture, and forestry
• Landscape and community fragmentation will exacerbate challenges
• Tailored adaptation is needed to respond to varying challenges and types of extreme weather events in different areas
• Existing adaptation and planning efforts are inadequate to respond to projected impacts
• Barriers to adaptation include funding, policies and institutions, and challenges in interpreting information
• Adaptation requires assessment of tradeoffs amongst costs, benefits, and risks of available options
• Climate change adaptation actions often fulfill other societal goals
• An evolving energy system is an opportunity to develop a system that is less vulnerable to climate change
Provide Your Comments

http://ncadac.globalchange.gov/

Accepting feedback on the draft report until April 12
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UPCOMING Webinars:
Community Engagement on Climate Response Decisions - The COAST Model
Tuesday, March 19, 12:00-1:30pm EDT
The Long-Term Vision: Developing a “Sustained Climate Assessment”
Thursday, April 24, 2013 1:15-2:45pm EDT