Governing California Through Climate Change

REPORT #221, JULY 2014

LITTLE HOOVER COMMISSION

DEDICATED TO PROMOTING ECONOMY AND EFFICIENCY IN CALIFORNIA STATE GOVERNMENT

Little Hoover Commission

Pedro Nava*
Chairman

Loren Kaye†
Vice Chairman

Katcho Achadjian
Assemblymember

David Beier

Anthony Cannella
Senator

Jack Flanigan*

Don Perata

Anthony Rendon
Assemblymember

Richard Roth
Senator

David A. Schwartz

Jonathan Shapiro

Sumi Sousa

** Served on study subcommittee*
†Served as subcommittee chair

Former Commissioners Who Served During the Study

Virginia Ellis

Bill Emmerson
Senator

Tom Quinn

Commission Staff

Carole D'Elia
Executive Director

Jim Wasserman
Deputy Executive Director

Ciana Gallardo
Research Analyst

To Promote Economy and Efficiency

The Little Hoover Commission, formally known as the Milton Marks "Little Hoover" Commission on California State Government Organization and Economy, is an independent state oversight agency.

By statute, the Commission is a bipartisan board composed of five public members appointed by the governor, four public members appointed by the Legislature, two senators and two assemblymembers.

In creating the Commission in 1962, the Legislature declared its purpose:

...to secure assistance for the Governor and itself in promoting economy, efficiency and improved services in the transaction of the public business in the various departments, agencies and instrumentalities of the executive branch of the state government, and in making the operation of all state departments, agencies and instrumentalities, and all expenditures of public funds, more directly responsive to the wishes of the people as expressed by their elected representatives...

The Commission fulfills this charge by listening to the public, consulting with the experts and conferring with the wise. In the course of its investigations, the Commission typically empanels advisory committees, conducts public hearings and visits government operations in action.

Its conclusions are submitted to the Governor and the Legislature for their consideration. Recommendations often take the form of legislation, which the Commission supports through the legislative process.

Contacting the Commission and Copies of Reports

All correspondence should be addressed to the Commission at:

- 925 L St., Suite 805, Sacramento, CA 95814
- E-mail: littlehoover@lhc.ca.gov
- Telephone: (916) 445-2125 Fax: (916) 322-7709
- Worldwide Web: www.lhc.ca.gov

This report is available from the Commission's website.

State of California

LITTLE HOOVER COMMISSION

July 10, 2014

The Honorable Edmund G. Brown, Jr.
Governor of California

The Honorable Darrell Steinberg
President pro Tempore of the Senate
and members of the Senate

The Honorable Robert Huff
Senate Minority Leader

The Honorable Toni G. Atkins
Speaker of the Assembly
and members of the Assembly

The Honorable Connie Conway
Assembly Minority Leader

Dear Governor and Members of the Legislature:

The ongoing efforts of national governments throughout the world to reduce carbon emissions that contribute to a warming climate have fallen short. We are beginning to see the initial effects of that warming. Climate specialists in California's research universities and state agencies consistently project now a new environmental reality: a rising Pacific Ocean along 1,100 miles of shoreline, irregular precipitation that includes downpours and drought, higher temperatures, larger, more destructive wildfires and diminishing snowfalls in the high country.

California is among the world leaders in efforts to curb carbon emissions through Assembly Bill 32, the Global Warming Solutions Act of 2006. State government has invested significant financial and staffing resources to this effort, which is providing value internationally as a driver of innovation and model for other nations to follow. Adapting to the actual impacts of climate change at home requires now the same, or even more robust, effort by state government. Governor Brown has received considerable attention nationally for declaring the need to prepare for climate change impacts. Yet in California, the activities and resources of state agencies in preparing climate change adaptation strategies still pale in comparison to the commanding efforts to reduce carbon emissions.

The Little Hoover Commission calls on the Governor and Legislature to assume the same leadership role in climate change adaptation and climate risk assessment as it has for addressing carbon emissions. California's continued success in software, global trade, entertainment, manufacturing, agriculture and biotechnology depends on California being synonymous with stability. The state's global stature and economic competitiveness has everything to gain from stepped-up and effective state-level preparedness strategies and management of climate impacts. It has much to lose if infrastructure to facilitate travel, goods movement, communications and public safety is perceived as unreliable or vulnerable to repeated disruption. Many vital sectors of California's $2 trillion annual economy are at stake. The Governor and Legislature must see that state government leads a smart, aggressive response to the uncertain climate conditions ahead.

State agencies have performed strong foundational work in climate change adaptation. The Commission acknowledges a depth of state-sponsored research and analysis in recent years. State government has made significant progress in understanding California's vulnerability, and in providing guidance to local governments about theirs.

But that is a bare beginning. Much more needs to be done, and in a more organized and centralized manner. State government climate adaptation efforts continue to be scattered across

a proliferation of agencies and departments. The status quo is slow, understaffed and inwardly-focused on state agencies. Many of the state's efforts to date have failed to aggressively reach out to local governments and the private sector for meaningful input. The state's official adaptation strategy, meanwhile, is advisory only. Statewide adaptation policy appears to be largely lacking. Actions by the Legislature to prepare, plan and invest in defenses against actual climate impacts also have been few – in vivid contrast to lawmakers' many significant policy directives during the past decade to reduce carbon emissions.

As a consequence of adaptation being secondary, many local officials on the front lines of dealing with coming climate impacts are confused. In their words, they lack time to be scientists and evaluate a growing body of often-conflicting information about anticipated climate impacts. Most are generally aware of their localities' broad vulnerabilities, but lack standardized information from the state about neighborhood- or block-specific risks, and most importantly, what they should do about them. The state's focus to date on broadly assessing the dangers to California must evolve to begin gaining command of the best-available risk assessment methodologies more commonly used by insurers and the private sector.

California will keep growing as climate change unfolds. The state will need new housing, new commercial development, new bridges and water treatment plants. It will need the best possible risk analysis tools to guide infrastructure investment, development and land use decisions, so as to avoid putting new growth in harm's way and wasting public funds. Presently, no one-stop source of trusted and reliable information exists to help guide those decisions. No single government structure exists within state government to compile and oversee that information.

The Little Hoover Commission, in this report, calls for the Governor and Legislature to create a new state entity or enhance the capacity of an existing state organization to establish and share the best-available state science and risk assessment procedures for anticipated climate impacts. The Commission envisions this entity becoming the authoritative source for local and regional governments to connect in two-way exchanges with the state for assessment of their climate risks. Critical to this entity in establishing the best-available information for climate impact decision-making will be inclusion of views from local governments, business and the private sector. Models already exist within state government. The Commission also calls for the Strategic Growth Council's planning and grant–making process to expand its focus beyond reducing emissions to also build stronger climate adaptation efforts in cities, counties and regions. Finally, the Commission calls for more aggressive enforcement of defensible space requirements to minimize property damage from wildfires, and for the Governor to work with key state agencies to clarify the impact of sea level rise on property rights under California's Common Law Public Trust doctrine.

The long-term impacts of climate change are just beginning. Much of California's future rides on effective preparation and response, both at the state level and at the critical nexus of state and local government. The recommendations in this report aim to strengthen the state's institutional capacity as it addresses the historic governing challenge ahead. The Commission respectfully submits these findings and recommendations and is prepared to help you take on this challenge.

Sincerely,

Pedro Nava
Chairman

Governing California Through Climate Change

Table of Contents

Executive Summary..... i
A Climate-Changed California..... 1
Governing for Climate Change..... 39
Commission Study Process..... 75
Appendices & Notes..... 79
- Appendix A: Public Hearing Witnesses..... 81
- Appendix B: Little Hoover Commission Public Meeting..... 83
- Appendix C: Significant State Government Research Initiatives Since 2006..... 85
- Appendix D: Cover Photo Credits..... 87

Notes..... 89

Table of Sidebars & Charts

Why a Warmer Climate Causes Extreme Weather..... 3
Current and Projected Temperature Extremes for the Los Angeles Area..... 4
Rollback of Air Quality Gains..... 6
The Great Blackout of September 8, 2011..... 7
The Whiz Kids Below Sea Level..... 14
Safeguarding California Strategies..... 17
Climate Action Team Representatives..... 18
Current State Efforts to Help Regions Begin Planning..... 20
The Big Metros Sponsor Groundbreaking Climate Analysis..... 24
One Answer: A $75 Billion Tidal Barrage at the Golden Gate..... 28
What to Do When Historical Data Becomes Irrelevant?..... 42
Broadening the Vision of Climate Governance..... 49
Key Concepts of Vulnerability and Risk..... 51
"Adapting to Rising Tides:" A Climate Risk Assessment Model for California..... 62
Existing State Processes Can Facilitate Stronger Regional Scale Climate Preparations.. 67
Similar Success: El Dorado County..... 68

Executive Summary

State government, which guided California through the instability of the Great Depression, managed the profound disruptions of World War II and steered, during following decades, one of the nation's great population, development and innovation booms, faces again an historic governing challenge in climate change.

A $2 trillion annual economy and the needs of nearly 40 million residents ride on the outcome of the state's preparations and response.

Climate change, which most scientists believe has already begun, promises decades of wilder weather and great uncertainty regarding the scale of annual precipitation, wildfire activity, sea level rise and daily temperatures. These changes have powerful implications for agricultural production, air quality, real estate values, electricity generation, public health and California's renowned quality of life.

State government – and cities, counties, special districts and regional authorities – will be obligated to defend their populations, economies and infrastructure, while continuing to accommodate new growth and development. Freeways, transit systems, international airports, hospitals, fire stations and water and sewage treatment facilities must remain operational and out of harm's way. Emergency response, public safety, communications, business activity and all the foundations of California's major role in the global economy must continue with a minimum of disruption.

Government, above all, must provide stability.

The roadblocks to effectively governing California through climate change are well identified and formidable. There are no guidebooks and little precedent for this new phenomenon. What works today for locating infrastructure and permanent buildings will not work tomorrow when a rising ocean is eroding not just shorelines, but the entire notion of permanent landscapes. Governments accustomed to meeting single targets of carbon reduction by specific percentages will surely struggle with the more difficult, multiple targets of climate adaptation. They also will struggle with the politics of investing today's tax dollars to protect tomorrow's residents from climate impacts.

Adapting effectively to climate impacts will require the public sector to reach comprehensive solutions, often at the regional level, to minimize individual, reflexive fixes that waste money and make problems worse – such as seawalls that merely push one city's problems onto its neighbors. California's tangled web of overlapping local governing agencies, its sprawling diffused networks of competing and shared interests steered by an endless array of political and governing cultures, have long proven their capacity for checkmate and stopping forward movement. State government's strength will be in providing the best-available climate impact science, standardized sources of information and sophisticated risk assessment tools to point the way to solutions and counter the potential for gridlock.

That is still more ideal than reality, however. The federal government is just beginning to grapple with the policy and organizational implications of addressing anticipated climate impacts. State government's executive branch has only in the past five years begun to focus its resources more intently on adaptation, while the Legislature has yet to engage in major adaptation policy. This shortage of emphasis compares to significant state investments and activity sanctioned by both branches to reduce carbon emissions through Assembly Bill 32, the Global Warming Solutions Act of 2006. Adapting effectively to the actual impacts of climate change along California's shorelines and in its cities, mountains and agricultural landscapes, will require a similar or even more robust investment of financial resources and effort on behalf of the state.

The Little Hoover Commission's study of climate change adaptation and governing challenges in California portrayed a state government that has far to go – understandably, and with much company elsewhere, given the uncertainty of climate change – in formulating necessary answers and actions regarding the dangers ahead. The well-being of millions of Californians alive today and the millions in generations ahead hinge on how state and local governments step up and respond to what Governor Jerry Brown has called "the world's greatest existential challenge – the stability of our climate, on which we all depend."[1]

A Summary of Commission Findings

The Commission began its climate change study process in August 2013 to review state government preparedness for what risk experts now widely foresee as a long-term and "slow-moving emergency." After three hearings, an advisory committee meeting and dozens of interviews with experts and interested stakeholders, the Commission concludes that:

- California state government has no single-stop administrative structure in place to create statewide climate adaptation policy,

overcome institutional barriers and govern the state's response to climate change impacts. Many state adaptation initiatives continue to be scattered among individual departments, agencies, commissions and councils.

- The state's adaptation strategies are still unfolding and relatively new, remain advisory in nature and require continuing evolution to assure comprehensive statewide responses to climate impacts. State government adaptation processes also have been conducted without widespread consultation of local governments and the private sector. The status quo is slow, understaffed and inwardly focused on state agencies.
- No single authoritative source of standardized information about climate risks in California currently exists within state government. Cities, counties, regional governing agencies and even the state lack reliable, consistent information to guide decision-making, particularly regarding long-range infrastructure investments and land-use choices. Local government leaders understand they are vulnerable to climate impacts, but lack more specific risk assessment capacity that would help guide planning and decision-making.

The Commission, in general, found encouragement in efforts by the state to understand the climate challenge and gauge its vulnerability. But in response to concerns raised during its study process about the state's organizational structures, it is calling for a more unified approach to adaptation on the part of state government.

This Commission report, divided into two chapters, contains scenarios and forecasts that may at times be unsettling, but also can prove to be thought-provoking and even hopeful. A state and nation that has reduced the scale of such environmental challenges as smog, acid rain and threats to the ozone layer may yet avoid the worst of climate change. The greenhouse effect will act on a long time scale and there is still time to react.

The first chapter describes the physical impacts that most scientists anticipate in California as a result of climate change, and portrays the first stirrings of a response by state and local governments. It also reviews the actions of the federal government and other coastal states, including Oregon, Washington and Florida. The second chapter portrays the institutional barriers to effective statewide responses to climate impacts and explores an entirely new dimension of assessing risk amid great uncertainty. Finally, it recommends establishing a new one-stop adaptation entity within state government to prepare for and respond to the impacts of climate change.

A State Still Seeking the Answers

The State of California, to its credit, has made considerable progress in understanding the climate risks ahead. The state is a leader nationally in analyzing potential impacts of a warming climate on its coasts, forests, farms and neighborhoods. State government agencies and public universities have compiled numerous studies reviewing potential impacts of an expanding ocean on coastal communities, and of rising temperatures on energy supplies, air quality, public health and agricultural commodities. Governor Brown, too, is among the most vocal and prominent elected voices nationally on the need to adapt to climate change.

Many of California's cities, counties and regions also are performing at the forefront and many have surpassed the state in planning for climate impacts. A growing number of communities are assessing climate risks for their airports, water treatment plants and roadways, and trying to integrate climate adaptation into everyday planning for their future development and population growth. In 2013, when the Rockefeller Foundation selected 11 climate-adaptive North American recipients for greater technical support and funding through its Resilient Cities Centennial Challenge, nearly half were cities in California - Los Angeles, San Francisco, Oakland, Alameda and Berkeley.[2]

While state and local governments study what might happen on the ground in California as a result of climate change, other fundamental questions also call for attention: How will the state most effectively govern during possible sustained periods of trial, disruption or emergency? What governing and administrative structures will best provide comprehensive regional or statewide solutions and minimize poorly-considered and wasteful community-by-community fixes? How might elected officials best budget today's tax dollars to prepare the state for tomorrow's uncertainty? What kind of land use decisions are most appropriate when long-held assumptions of predictable, stable geography in which to live, work and build permanent buildings are no longer relevant?

The Commission's study process portrayed a state still seeking the answers.

There is not much of a game plan beyond a growing stack of studies and plans.

After a year of review, the Commission learned that California's lack so far of a unified strategy for climate adaptation stands in sharp contrast to its targeted efforts to reduce greenhouse gas emissions. The State of

California arguably leads the world with powerful laws, strategies and governing mechanisms to reduce carbon emissions to 1990 levels by 2020 – and an additional 80 percent below 1990 levels by 2050. Since passage of AB 32, the Global Warming Solutions Act of 2006, CARB has become one of the state's most powerful agencies. It runs a model cap and trade program that is steering hundreds of millions of dollars and eventually billions to the state's Greenhouse Gas Reduction Fund for high speed rail, targeted funding for energy efficiencies in disadvantaged communities and further curbs in carbon emissions. A powerful political constituency advances and guards this effort, which has greatly boosted California's reputation for environmental innovation.

While the state's considerable effort affects less than one percent of global emissions, it is spurring powerful innovation for clean energy and potentially offering a model for other states and nations to accomplish carbon reduction. The value of California's AB 32 program can be said to extend well beyond its immediate quantifiable impact by propelling and accelerating knowledge for global solutions to carbon emissions.

Many believe it's time for a similar California-led effort on behalf of adaptation, one that will pay immediate dividends at home, as well as internationally in the longer term. Daniel Mazmanian, a University of Southern California public policy professor and chair of a 2010 Pacific Council on International Policy report on climate adaptation strategies for California,[3] told the Commission, "What is disheartening, in view of California's reputation as an environmental policy leader, is the reluctance of the state's policy makers to address as boldly the ramifications of a changing climate that will be visited on the people of California."

In written testimony to the Commission on August 22, 2013, Mr. Mazmanian stated: "In specific, the Legislature has not established policies and goals. Nor has the Governor promulgated executive orders for adaptation comparable to the demanding, quantitative and highly publicized targets set for greenhouse gas emissions reduction."[4]

Robert Verchick, professor at the Loyola School of Law in New Orleans, provided similar Commission testimony to the Commission. "Historically this state been setting some very good planning for climate change and it's well respected throughout the world," he stated. "The harder thing to do, which is what you're embarking upon, is how to do something about it."

Adaptation Efforts Are Scattered Throughout Government

California's formidable track record of overcoming adversity has long included recovering and rebuilding after earthquakes, floods, wildfires and landslides. Indeed, the Governor's Office of Emergency Services views climate change not as a new and unique hazard on California's horizon, but as a magnifier of its existing natural hazards. The same standardized Incident Command System that governs current emergency responses with local control and backup from state and federal forces also will confront impacts of climate change. Similarly, state government agencies that routinely oversee issues of protecting natural resources, allocating water, building infrastructure, guarding public health and meeting demands for energy also are individually planning for climate change impacts within their existing practices.

Yet during its 10-month study process, the Commission learned one thing clearly about California's readiness for climate change. While the state has broadly and successfully assessed its potential vulnerability and often leads other states in its research, the work of climate adaptation is scattered throughout state government and lacks an organization, a leader and a home. Despite a cross-agency Climate Action Team in place within state government and a 2009 California Adaptation Strategy report and its Safeguarding California update being finalized in 2014 by the California Natural Resources Agency, the threads, so to speak, still have not been pulled together in a way that helps people on the ground make decisions.

Burlingame Mayor Michael Brownrigg referenced this muddle of random information during a December 2013 sea level rise forum in San Mateo County. Addressing fellow local officials, Mayor Brownrigg said, "I've heard a lot of challenges, and I haven't heard so many options. Maybe this takes a lot more process and stuff, but meanwhile I'm sitting, and my councilmembers are sitting, and we're wondering what should we be doing about it? Should we be putting money against this? Should we be doing hardscape? How do I protect my hotels? That's what I'm hungering for. What do I do about it? I get that there's sea rise. But what do we do about it?"

Such questions in the absence of mutually-agreed upon solutions and risk assessment protocols from the state have sent regions scrambling to assemble their own understanding of local impacts and possible solutions. Los Angeles, the San Francisco Bay Area, San Diego and Sacramento have each taken different approaches. But each region also has formed a climate adaptation "collaborative," consisting of government and non-profit and private sector representatives to address climate change. Members of those collaboratives have, in turn, organized into

one large statewide collaborative, the Alliance of Regional Collaboratives for Climate Adaptation, to speak with one voice to state government. Many regional and local officials told the Commission in hearings that they felt shut out of state climate adaptation deliberations and were not at the table to help develop the state's 2009 California Adaptation Strategy and Safeguarding California update. The feeling goes both ways, however. The state's representatives sometimes contend that local governments and officials, with their insistence on local control of development and other issues, work contrary to larger state goals for long-range climate adaptation.

At Stake: California's Economic Competitiveness

It is hard to overstate how much is at stake for getting climate adaptation right in California. The state's economy is highly globalized, dependent on complex supply chains and logistics that are at potential risk of being destabilized by sea level rise, flooding and other impacts. The Port of Oakland, for instance, might remain operational after a storm surge at higher tides than now familiar. But extended flooding of a nearby Bay Area freeway could disrupt agricultural exports from the San Joaquin Valley hundreds of miles away.

The Commission heard much from the private sector at hearings about the importance of keeping California stable. Businesses will be on the move in search of safe operating environments amid the uncertainty of climate change, making winners of states and regions that can provide them. State government, in partnership with cities, counties and regional governing bodies, carries the responsibility of protecting and investing in both concrete and natural infrastructure, communications, emergency response capacity and public health. State government, in particular, must ensure optimum conditions for dependable electricity and water supplies and reliable transportation and goods movement.

Specifically within the private sector, farmers require control of pests and government-sponsored research into new varieties of heat-resistant crops. The Pacific shipping industry needs seaports that withstand sea level rise and provide safe harbor from powerful storms. At least three major California airports, in San Diego, San Francisco and Oakland, require long-term improvements to keep rising water at bay and passengers and cargo moving. Employees at all these business operations must be able to get to work, whether by highway or public transit. Goods, too, must be able to move uninterrupted by rail and truck, to keep critical global supply chains operational.

The Commission's Proposals

The Little Hoover Commission traditionally avoids recommending the creation of new state agencies or governing structures, in belief that government can best accommodate new problems with existing structures. But climate change will be an historic challenge, a transformative condition requiring the best-available science and most sophisticated risk assessment tools with which to help California's multitude of governments prepare and react.

Governments at all levels clearly need a new authoritative and trusted source of information to assess risks and guide decision-making, not at the 50,000-foot level, but in their downtowns, within a four-block area or at a single freeway interchange. The Commission calls on the Governor and Legislature to create a new state entity or enhance the institutional capacity of an existing organization to provide them the best and newest science and risk assessment methodologies as they evolve. The entity, however structured by the Governor and Legislature, should include an independent science board such as that which guides the Delta Stewardship Council and Ocean Protection Council. A single reliable source of standardized and updated information reviewed by a science board could create conditions for smarter response at all levels of California government. Quickly, it would stimulate better land use decisions, providing local elected officials agreed-upon facts and cover for controversial decisions about whether or not to approve development proposals that might be endangered in the future, or worse, removed at great public expense. Eventually, governments would begin to incorporate risk assessment provided by a new or existing entity into all their long-range planning, embedding adaptation into local general plans, infrastructure reviews and planning processes statewide.

Officials in the insurance sector assured the Commission that all the tools available to insurers and the private sector to assess risk are available to the public sector. Expert use of these tools by the state would have the added benefit of making the private insurance market work more effectively in California. The insurance industry's ability to absorb risk and costs of disaster, industry witnesses testified to the Commission, relies on the government sector's ability to keep the maximum number of people and properties out of harm's way.

The Commission also calls for the California Strategic Growth Council to expand its focus beyond reduction of carbon emissions to include a greater emphasis on adaptation to the impacts of climate change. The council's grant-making processes and review of state infrastructure spending are important tools to fund climate adaptation efforts. The

Strategic Growth Council, created in 2008 to align state infrastructure spending and other investments with state growth goals – while limiting greenhouse gas emissions – already has begun to provide grants for regional adaptation initiatives. The council's mission to steer more residential and commercial development to existing urban areas has potential to unwittingly move more people and property into harm's way. An expanded focus on climate impacts and adaptation will help balance state growth policies with those of climate adaptation.

In addition, the Commission recommends enforcement of defensible space requirements in state law since 2005 to minimize property damage from wildfire. The law requires property owners within fire-prone areas to maintain 100 feet of cleared space around their buildings. But most counties lack aggressive ongoing enforcement of the law. The Commission notes Ventura County's success in reducing wildfire damage due to inspections and enforcement, hiring of contractors to clear land of those not complying, as well as sending bills and charging administrative fees.

Finally, the Commission urges the Governor and Legislature to avert potential legal dysfunction by clarifying California's Common Law Public Trust Doctrine in light of a rising ocean that will eventually begin to condemn private property. Few yet know that a rising ocean moving onto beachfront private property will legally convert it to public property via provisions in the California Constitution. This portends potential controversy and crippling litigation in the courts. The Commission recommends that key state agencies meet to clarify the impact and create a legal framework in advance.

Conclusion

Two other states with significant populations and large economies, New York and New Jersey, endured the worst natural disaster in their histories on October 29, 2012, when Hurricane Sandy blew ashore in the dark. The shocking scale of devastation – 43 deaths and an estimated $19 billion in damage in New York City alone – prodded a rapid transition from complacency about climate change to government action on a $20 billion resiliency plan, "A Stronger, More Resilient New York." The plan and a governing structure to implement it, approved within eight months of the storm's fury, cited the immense stimulus of a wake-up call and stated, "When the waters receded, New York was, in many ways, a changed city."

The Little Hoover Commission, during its study process of climate change adaptation, heard repeatedly that California has yet to experience

its "Sandy," and consequently, is not yet the changed state it must become. California's will to act and defend itself against the uncertainty of a changing climate continues to remain less than urgent. While it is admittedly hard to organize the nation's most populated state against uncertain threats occurring in an undefined future, the responsibility to lead this change belongs with state government. The model for change is California's global standing as an innovator, a force driver and early adopter in curbing greenhouse gas emissions and passing AB 32 in 2006. No American state has done more. California serves as a road map to decarbonizing the economies of entire nations.

Adapting to impacts of climate change requires the same effort and more. At a January 16, 2014, hearing by the Assembly Select Committee on Sea Level Rise and the California Economy, Nadine Peterson, deputy executive officer of the California Coastal Conservancy, told lawmakers, "To move to the next level, to more fully prepare our communities for the climate and sea level rise adaptation challenges that we know lie ahead, California must repeat the strong political will, leadership and commitment, including the commitment of financial resources, that we demonstrated with the passage and implementation of the Global Warming Solutions Act."

The State of California faces many tough calls with climate change. State government and other public institutions will conduct an often-thankless exercise of picking winners and losers – yes or no on proposed development projects in questionable areas or costly defensive investments appearing to favor one city over another – in social and political environments that are likely to be uncertain, anxious and contentious. It will take institutional capacity and expertise, at and likely beyond, the scale of current state efforts to reduce greenhouse gases.

Always, California has prevailed when tested by weather, by natural disaster or by human circumstances. But it will need new methods, a new governing system for this new problem likely to rival all of its greatest historical challenges. History this time likely will not be a good guide. As Mr. Verchick of Loyola University in New Orleans, testified to Commission at its August 22, 2013, hearing, "With climate change all bets are off. The one thing we know is that the future will not be like the past."

Recommendation 1: The Governor should direct his administration – either through creation of a new state organization (via legislation) or delegation to an existing state entity that has capabilities to perform the mission – to establish the best state science on anticipated climate change impacts and help decision-makers accurately assess their climate risks based on that science.

- A new organization or existing entity should be advised by an independent science board to assess and establish the best possible statewide, regional and local standards by which to measure anticipated climate impacts and risks. Those standards would evolve as the scientific understanding of climate change impacts evolves.
- The organization should not make policy on climate change adaptation. It would exist to inform government regulators, land-use permitting agencies and infrastructure planners, providing the best available information and standards to guide decisions about locating or relocating development and infrastructure. State, regional and local agencies would plan to those standards, incorporating a common, consistent vision of climate change adaptation over time into all the state's planning efforts.
- Members of a new state entity, if established by legislation, should have technical expertise in climate change adaptation and be representative of state and local public- and private- sector interests throughout California. Members could serve part-time and be appointed by the Governor and require confirmation by the Senate. To maintain its independence, the new entity would not exist within the Governor's Office.
- The Governor should issue an Executive Order to mandate that state government agencies plan to the new or existing entity's standards as they are developed.

Recommendation 2: State government at all levels should further incorporate climate risk assessment into everyday public planning and governing processes throughout California.

- State government agencies should stimulate and fund more regional pilot projects such as the San Francisco Bay Conservation and Development Commission's $1.6 million "Adapting to Rising Tides" risk assessment on 26 miles of Alameda County shoreline.
- State government agencies should make climate change risk assessment an eligibility factor for all infrastructure, planning and program grants to regions. Governments at all levels should build climate risk assessment and adaptation into general plans, hazard mitigation plans and all local planning processes.

- The state should promote regional planning approaches and governing mechanisms when funding climate adaptation for cities and counties. Examples include special districts that cross jurisdictional boundaries for climate adaptation purposes, joint powers authorities and specific memorandums of understanding for multi-party adaptation projects.

Recommendation 3: The Legislature should expand the primary mission of the Strategic Growth Council beyond mitigation of greenhouse gas emissions through the SB 375 Sustainable Communities Strategy to include an equal focus on climate change adaptation in California. The Council's operating guidelines and charge to support planning and development of "sustainable communities" should stretch to include the ability to identify and address climate impacts appropriate to the community or region.

- The Legislature should incentivize and require recipients of Strategic Growth Council grants and SB 375 funding for transportation emissions reductions to build additional climate change adaptation considerations into their growth policies and climate mitigation projects.
- The Strategic Growth Council should use its responsibility to review the state's five-year infrastructure plans to foster greater emphasis on climate change adaptation in state infrastructure investments. Climate-focused reviews of statewide infrastructure investments will provide a model process and help regions and localities strengthen review of their own infrastructure investments.

Recommendation 4: State government should work with counties, private insurers, wildland stakeholders and the building industry to minimize wildfires and property damage by more aggressively enforcing defensible space requirements existing in state law. The state and stakeholders should promote Ventura County's success in enforcing compliance and reducing wildfire costs and damage as a climate change model for wildland urban interface areas.

Recommendation 5: The Governor should work with key state agencies such as the Attorney General's Office, State Lands Commission, Coastal Commission and other public and private coastal interests to clarify the impact of sea level rise on California's Common Law Public Trust Doctrine. A collective dialogue should seek ways to create a legal framework in advance of crisis and prevent litigation and instability as a rising ocean begins to condemn private property on the Pacific coastline.

A Climate-Changed California

In this century, California faces another great test of its spirit and ingenuity. The sunny Mediterranean climate that provides the state its famed quality of life is beginning to change. Temperatures are slowly on the rise as heat-trapping greenhouse gases accumulate in the atmosphere and also warm the earth's oceans. These gradual changes are supercharging the world's climate, scientists say, creating conditions for more extreme weather and all that comes with it for human beings and wildlife – enduring, overcoming and prevailing through adversity.

Bluntly stated, international efforts to prevent a warming climate by reducing carbon emissions have fallen short. While continued efforts to decarbonize economies will eventually reduce the scale and intensity of climate change, California for now must prepare for the inevitable.

During a year-long study, 24 public hearing witnesses and many others told the Commission that failure to prepare and respond effectively will bring unnecessary misfortunes in the long run to the state's residents, environment and economy.

"California, with all its valuable coastal assets, its expansive farming, its areas prone to floods and other areas prone to extreme drought and heat waves, is in the bulls-eye, and coming from Louisiana, I know what that feels like," witness Rob Verchick, professor at the Loyola School of Law in New Orleans, testified during an August 22, 2013, hearing before the Commission. "We're locked into a future in California and elsewhere," he said, "a future that is going to be hotter, it's going to be wetter, it's going to be drier and it's going to be wilder with many more kinds of extreme events."

Governments at all levels in California face risks of overinvesting precious financial resources in uninformed and perhaps unnecessary responses, just as they will risk investing too little. Already, groups such as the Santa Monica-based Rand Corporation and others are using and refining analytical processes to evaluate investment options in the face of deep uncertainty. As the Commission heard repeatedly during its study process, it will cost less to prepare in advance for these events than for continual emergency response and rebuilding.

A New Environmental Reality

Climate threats identified in a growing body of California state government studies include:

- ***Sea level rise:*** The Pacific Ocean will expand and move inland as ice sheets melt and warm water increases in volume, attacking, eroding and flooding 1,100 miles of the state's developed and natural coastline. The notion of stable, predictable geography in which to live, work and build permanent buildings will be off the table in decades ahead.
- ***Violent storms and inland flooding:*** Annual precipitation will likely stay within familiar bounds, but seasonal timing of precipitation will shift as warmer weather produces violent storms and downpours that cause creeks and rivers to escape their banks. Floods associated with 100-year frequencies or 500-year frequencies could occur several times within one person's lifetime.
- ***Wildfire:*** Warmer, drier conditions in California's mountains and foothills are expected to elevate the number and intensity of wildfires throughout the state. Wildfires are already the most common disaster in California and the third highest source of death, injury and financial damage after earthquakes and floods.
- ***Energy:*** The increasing frequency and duration of heat waves will strain energy supplies. Energy demand is likely to rise while energy generated from hydropower declines due to dwindling snowfall and runoff in the Sierra Nevada.
- ***Public health:*** Prolonged heat waves in areas where residents can't afford high air conditioning bills and must work outside, especially in the lower-income Central Valley, could cause more sickness, disease and deaths.
- ***Air quality:*** More frequent episodes of extreme heat and wildfire will accelerate formation of smog and other harmful pollutants, potentially rolling back clean air improvements.
- ***Agriculture:*** Plants may flower earlier and become desynchronized from pollinators. New pest invasions could materialize. Crop patterns could change and will require extensive breeding of newer heat-resistant varieties.
- ***Environment:*** Native fish species may become extinct as higher temperatures warm up their inland rivers and lakes. Natural areas will be inundated by sea level rise.
- ***Water shortages:*** A diminished Sierra Nevada snowpack and drought could reduce water supplies and invite still-fiercer fights among cities, farms and the environment.[5]

Many of these already are familiar California conditions, skillfully handled by an experienced emergency management system. Yet the widening scope of these anticipated climate impacts suggests still greater potential for damage to property, infrastructure and the natural environment, disruption of supply chains, physical injury, financial insecurity and higher insurance rates. The government sector may confront periodic episodes of human dislocation within the state and climate-driven migrations from other states and nations into California. Higher temperatures will facilitate greater incidences of disease with many of the effects falling hardest on the very young, poor and elderly. Other longer-term warming scenarios detailed inside state agency studies range from heat-stressed Central Valley dairy cows producing less milk to poorer-quality growing conditions for the state's signature wine-making industry.[6] University studies foresee the San Francisco Bay Area becoming warmer, drier and more like Santa Barbara County, while Mojave Desert conditions gradually move north into the San Joaquin Valley.[7] Others anticipate Southern California's notorious autumn Santa Ana winds blowing less frequently due to reduced temperature differentials between the land and ocean.[8] And throughout the state, say environmental researchers, plants and animals will seek migratory routes to cooler, higher and more hospitable terrain.[9]

Why a Warmer Climate Causes Extreme Weather

Scientists predict that a warming climate will bring more extreme weather events such as drought, heat waves, floods and storms. Here is a brief explanation of how a warming climate is linked to these extreme events:

Drought and floods: A warmer climate increases evaporation from soils, oceans and other bodies of water, causing the atmosphere to store more moisture. More water vapor in a warmer atmosphere causes precipitation to fall harder when it falls, driving heavier rainfall and blizzards. But additional moisture-holding capacity also stimulates even more evaporation from land, which causes drought.

Hurricanes and storms: Rising ocean temperatures release more water vapor into the air. Hurricanes get more energy from extra water vapor and create more intense storms.

Source: Heidi Cullen. 2010. "The Weather of the Future." Page 54-56. New York, NY.

Rising Temperatures, Extraordinary Circumstances

In 2013, the California Energy Commission (CEC) reported that average California temperatures have risen approximately 1.7 degrees Fahrenheit from 1895 to 2011.[10] The National Oceanic and Atmospheric Administration (NOAA) called 2013 the "37th consecutive year that the yearly global temperature was above average." According to NOAA, nine of the 10 warmest years globally during 134 years of record-keeping have occurred in the 21st Century.[11]

A 2012 CEC-led research assessment projects continued warming:

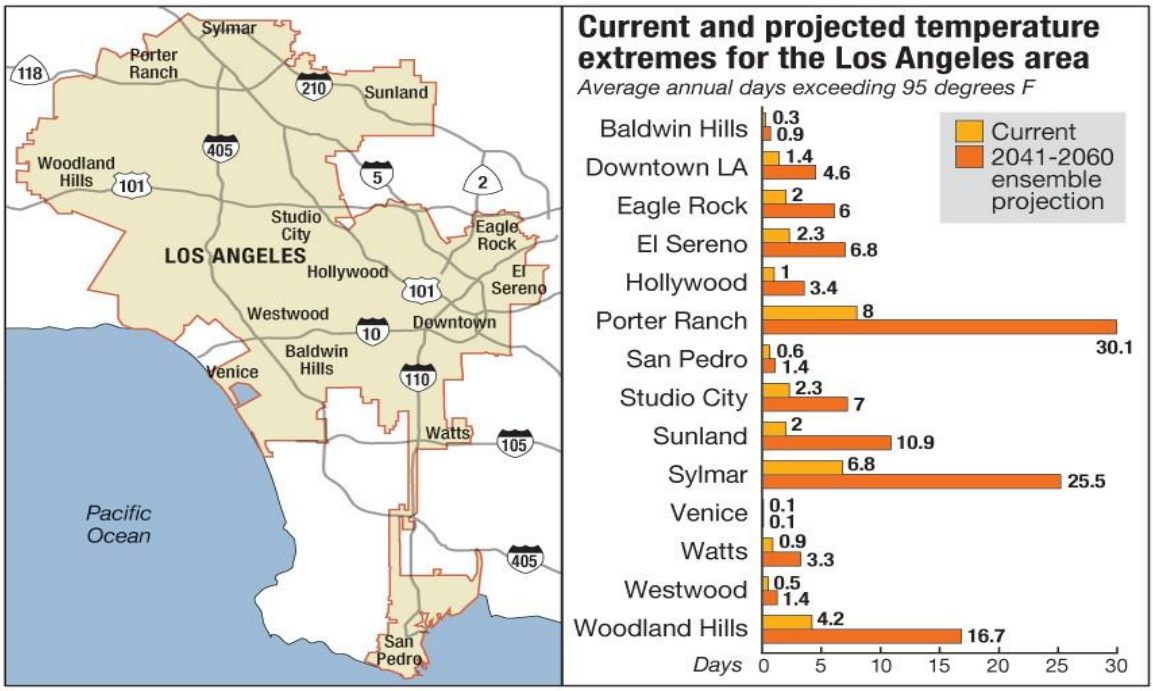
- By 2050, annual statewide temperatures in California will increase on average another 2.7 degrees Fahrenheit above the

2000 average. This anticipated rise is three times faster than the gradual rate of warming during the past century.

- By 2100, temperatures may average 4.1 to 8.6 degrees Fahrenheit above 2000 levels. The range depends on whether global carbon emissions are reduced or continue to increase.[12]

A 2013 study by the University of California, Los Angeles (UCLA), takes a harder line, projecting a four-to-five degree climb in average temperatures by 2050 in the Los Angeles region – home to more than 191 cities and 18 million people.[13] The UCLA study, funded by the U.S. Department of Energy and among the most sophisticated computer modeling efforts undertaken at a regional scale, forecasts a substantial increase in "extreme heat days" throughout the Los Angeles region (when temperatures exceed 95 degrees Fahrenheit). Study director Alex Hall, professor in the UCLA Department of Atmospheric and Oceanic Sciences, testified to the Commission on October 24, 2013, that fast-growing inland desert and valley cities will see the biggest impacts. By 2050:

- The Coachella Valley's Palm Springs metropolitan area will average 119 extreme heat days. The current average is 75 days.
- The San Joaquin Valley's Bakersfield area will experience 90 days of extreme heat, a near doubling of current averages.
- The Inland Empire's Riverside metro area will see annual extreme heat days more than triple, to 34.



Source: "Mid-Century Warming in the Los Angeles Region." 2012. University of California, Los Angeles, Institute of the Environment and Sustainability and the Los Angeles Regional Collaborative for Climate Action and Sustainability. http://c-change.la/temperature.

Downtown Los Angeles, by contrast, will experience an average of five extreme heat days annually in 2050, compared to less than two today. (However, the highest temperature ever recorded in downtown Los Angeles was 113 degrees Fahrenheit on September 27, 2010, a "precursor of what may face LA in the future," according to the study. The heat event triggered a record 6,177-megawatt peak load for the Los Angeles Department of Water and Power).[14]

Extreme Heat and Real Estate Values

Temperature differences by city and neighborhood ultimately suggest that real estate and property values may become the primary lens through which Californians come to understand climate impacts. Extreme heat will make inland ZIP codes less desirable and those near the ocean yet more expensive, said Matthew Kahn, a UCLA professor of economics and public policy, and author of the 2010 book, "Climatopolis." Mr. Kahn has suggested that heat may drive California's largest metropolitan area to remake itself in the intensively developed manner of Hong Kong, with its population increasingly clustering near the temperate coastline.

In the Bay Area, Will Travis, former executive director of the San Francisco Bay Conservation and Development Commission (BCDC), suggested rethinking California's development patterns in light of climate change. Mr. Travis told the Commission that sustained migration of residential and commercial development to California's hotter inland valleys as coastal urban areas resist development "is strategically the worst way for California to grow" in an era of climate change. Mr. Travis, in written testimony to the Commission on October 24, 2013, said the state should take advantage "of the mild Mediterranean climate along the coast where nature provides free air conditioning, heating and cooling costs are lower, energy consumption is far less and the goals of SB 375 (the Sustainable Communities and Climate Protection Act of 2008) can be more easily achieved."

A Public Health Crisis

Prolonged heat waves in inland cities where many residents cannot afford high air conditioning bills are likely to go well beyond concerns about property values and discussions about growth. Sustained heat episodes will likely become a public health crisis, causing more sickness, disease and deaths, especially among the elderly, the poor and socially isolated. California's most deadly heat wave occurred in 1955 when 946 Southern Californians died during eight days of extreme temperatures, according to the 2013 California Multi-Hazard Mitigation Plan published

Rollback of Air Quality Gains

California's air pollution specialists fear that longer and more frequent heat waves will combine with additional smoke from wildfires to roll back hard-won improvements in air quality. An April 2014 report by the California Air Pollution Control Officers Association stated: "While dramatic progress has been made in reducing air pollution and meeting air quality standards over the years, the effects of climate change threaten to reverse this progress and diminish decades of investments made to improve air quality. The higher number of extreme heat days and heat waves predicted to occur as a result of climate change will increase smog formation, increase the number and severity of wildfires, worsen heat island effects in urban areas, and increase adverse health effects due to the public's increased exposure to harmful air pollutants."

Source: California Air Pollution Control Officers Association. April 2014. "California's Progress Toward Clean Air 2014." http://www.capcoa.org/wp-content/uploads/2014/04/CA_Progress_Toward_Clean_Air_Report_2014.pdf

by the Governor's Office of Emergency Services. The California Department of Public Health reported that a 10-day 2006 heat wave caused 650 deaths in California and sent thousands to hospital emergency rooms. A 2003 European heat wave, considered the "worst natural disaster in the developed world in modern history," killed an estimated 70,000 people.[15]

Managing Adversity

California is likely to fare better than other states as heat begins to take a toll on major desert cities such as Phoenix and humid metro areas in the Midwest. Some, like Mr. Travis, told the Commission that California's reputation for mild coastal weather will remain intact and likely become a magnet that attracts more newcomers. Others, like UCLA's Professor Kahn, said it is likely that Californians will see big advances in air-conditioning technology, a proliferation of social media coping tools and other innumerable yet-unknown innovations to take the edge off a hotter climate. "Most people want their children and grandchildren to have a great quality of life," he told The San Jose Mercury News in August 2013. "We are going to get future Amazons, Apples and Facebooks out of this that will address the challenges."[16]

The Commission heard from several business sectors offering similar resolve at its February 27, 2014, hearing. San Francisco International Airport, a key economic pillar of Northern California and the Pacific Rim, described itself as aggressively assessing its risk and investing – in sea walls and interior drainage – not retreating in the face of sea level rise. San Diego Gas & Electric described new generations of smart grid technology and time-sensitive pricing to help it manage energy demand. The building industry described how new houses increasingly resist fire. The agricultural industry anticipates breeding newer varieties of plants and trees to resist rising temperatures.

Government will have equivalent opportunities to innovate as it addresses and guides responses to climate challenges within the public sphere. As the private sector envisions opportunity in changing conditions, California's state and local governments will serve best by imagining and acting on similar possibilities.

Implications for Water and Power

In California's mountain ranges, rising temperatures are limiting high country snowpack critical to the state's complicated water delivery and energy systems. Water managers inside state government, water districts and electrical utilities uniformly report less snowfall and earlier melting. These losses are projected to accelerate in coming decades.

The 2013 computer modeling study by UCLA's Professor Hall estimates that the San Gabriel, San Bernardino, San Jacinto and San Emigdio/Tehachapi mountain ranges that ring Southern California will lose up to 42 percent of their current annual snowpack by 2050 and as much as 66 percent by 2100 if nations fail to curb their carbon emissions. (Successfully reducing emissions could cut that decline in half by 2100, the UCLA study estimates).[17] Professor Hall told the Commission he plans a similar study of the Sierra Nevada snowpack that powers the state's urban and agricultural economies. The state Department of Water Resources (DWR) has already forecasted that "the Sierra snowpack will experience a 25 to 40 percent reduction from its historic average by 2050."[18]

Water distribution has always been complicated in California, but a future in which irregular precipitation becomes the norm will likely stretch the very limits of the delivery system and the legal structure that supports it. The severe water shortages of 2013 and 2014 – a direct result of inadequate snowfall in California's mountain ranges – already are triggering regional divides and political infighting that hint at battle lines of a climate-impacted future.

Rising statewide temperatures pose particular challenges for California's energy sector. Electrical generation equipment runs less efficiently during episodes of extreme heat, reducing generation capacity at precisely the time it is most needed.[19] Thousands of miles of energy transmission lines cross mountain terrain prone to forest fires. An expanding population of residential and commercial customers is expected to respond to extreme heat by collectively turning up the

The Great Blackout of September 8, 2011

Thursday, September 8, 2011, stands out as a vivid example of how extreme heat and a strained power grid – a dangerous combination that may become common in a warmer climate – can grind entire regions and economies to a standstill. An estimated 2.7 million electricity customers in Southern California, including all of San Diego, as well as parts of Southern Arizona and Baja California, Mexico went without electricity, some for nearly 12 hours. Federal authorities attributed the chaos to an 11-minute disturbance among five utilities that triggered a series of cascading outages. The disturbance occurred near rush hour, snarling traffic for hours. Schools and businesses closed, flights and public transportation were disrupted. Water and sewage pumping stations lost power and triggered sewage spills that closed beaches. Millions had no air conditioning on an unusually hot weekday afternoon. It was said to be the largest power outage in California history.

Source: Federal Energy Regulatory Commission and the North American Electric Reliability Corporation. April 2012. Arizona-Southern California Outages on September 8, 2011 – Causes and Recommendations.

air conditioning. Hydropower, which supplies 20 percent of California's energy generation, according to the state's 2013 Multi-Hazard Mitigation Plan, also will diminish in scale. Pacific Gas and Electric expects that a warming climate and reduced snowpack will begin to negatively impact the utility's hydroelectric production around 2025.[20]

But, as San Diego Gas & Electric representatives testified to the Commission on February 27, 2014, preparations for all these scenarios are underway. The utility has begun to "harden" transmission and distribution infrastructure in its Fire Threat Zone, replacing more than 3,000 wooden power poles with steel poles and adding 144 remote weather stations in the back country. Robert B. Anderson, the utility's director of resource planning, also testified that the electrical grid is likely to remain reliable through "rate design that provides customers with price signals on when to wisely and efficiently use energy." Forecasts for growth in peak demand periods "heavily driven by residential air conditioning" can be planned for and managed, Mr. Anderson told the Commission.

Finally, the Commission learned of a peculiar issue faced by California utilities that takes on new relevance with a changing climate. Utilities are legally obligated to service new residential and commercial development, but have no say in government land use decisions that can place it in harm's way of fire and flooding. Representatives of Pacific Gas and Electric told the Commission that utilities "have no ability to decline politely" and must assume risks of questionable land use choices made in the absence of reliable statewide sources of climate risk assessment information.

Recalibrating Agriculture

California's export-driven $44.7 billion agricultural industry also is beginning to assess its options in the face of warmer temperatures, particularly at night. Farmers say they are already seeing higher nighttime temperatures in summer and fewer winter chill hours – defined as 45 degrees Fahrenheit and below. Scientific studies cited in a 2013 report by California's Climate Change Consortium for Specialty Crops suggest that even a two-degree warming could impact the state's agricultural landscapes. Members of the consortium, assembled by the California Department of Food and Agriculture, stated: "In some areas, certain crops will no longer be viable; simultaneously, there may be opportunities to grow these same crops (or new ones) in other regions of the state."[21]

Prospects of higher temperatures and longer growing seasons are expected to be good news for some crops, boosting yields for the state's

lucrative almond and strawberry crops, for example. But the same conditions also may lower yields of temperature-sensitive cherries and wine grapes "to economically unsustainable levels."[22] A separate 2013 study, published in the Proceedings of the National Academy of Sciences, stated that major wine-producing areas such as California could experience sizeable decreases in acreage and relocation to cooler latitudes such as the Pacific Northwest. The study projected a potential 60 percent decrease in suitable California viticulture acreage as early as 2050. Yet it suggested winemakers also might adapt by marketing varietals with altered climate tolerances and flavors similar to today's favorites.[23]

"There are a lot of examples of (agriculture) being hard hit by shocks and being able to overcome them," said agricultural historian Alan L. Olmstead during a May 19, 2014, climate change conference in Sacramento convened by the Giannini Foundation of Agricultural Economics at the University of California, Davis. "It's not to say this won't be hard or won't work," said Olmstead, a Distinguished Research Professor of Economics at UC Davis. "But patterns of the past have shown reasonable accommodation. Added fellow agricultural economist Marshall Burke at the Giannini gathering: "I think our options (in California) are better than the U.S. But water will be a key."

"Drought is different. It is gradual and drawn out. You don't know you are in it until it is already well begun, and you never know when it will end. An earthquake shudders and is over; a fire blazes and dies; a storm finally passes. But a drought creeps on."

William deBuys, author. "A Great Aridness." Oxford University Press, USA. 2013.

California's $2 billion citrus industry is among those considered temperature sensitive by the CDFA climate change consortium and concerned about water. Joel Nelsen, president and chief executive officer of the Exeter-based trade association, California Citrus Mutual, testified to the Commission that citrus trees can withstand a few degrees of warming, but will likely encounter worsening water shortages and pest invasions that will require greater use of chemical spraying. Mr. Nelsen said the industry could conceivably relocate outside California if warming scenarios become dramatically worse than anticipated, but is currently giving that prospect little consideration. "We're not going anywhere. We'll be here for the next 100 years," he said at the Commission's February 27, 2014, hearing. But he said the ultimate impacts of higher temperatures, if they rise to the extent predicted, could be a shorter growing season, smaller annual crops and a diminished industry with fewer acres, packinghouses and jobs. California grows 85 percent of the nation's fresh citrus fruit and is a major citrus supplier to China, Japan and South Korea.[24]

Nelsen, speaking for the state's larger agricultural industry, told the Commission that state government should adopt a light regulatory touch, considering the wide variety of commodities grown within California. "Annual crops, whether they be grains or vegetables, 120-day row crops, permanent crops and animals all have different dynamics. Individually,

and as commodities, they will adapt in our view. The role of government is to allow that to happen without trying to manage change," he testified.

A Rising Pacific Ocean

"Erecting a Gothic cathedral along the shoreline and expecting it to endure 1,000 years would not be prudent."

Will Travis, former executive director, San Francisco Bay Conservation and Development Commission.

The most dramatic effects of climate change are projected to occur along California's 1,100 miles of coastline. Tidal gauges in place since 1855 at San Francisco show a seven-inch rise in sea levels during the past century.[25] A 2012 National Research Council study commissioned by the states of California, Oregon and Washington (and sponsored by the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey) estimated that sea levels between the Mexican border and Humboldt County in Northern California could rise two to 12 more inches by 2030 and as much as five to 24 inches by 2050. By 2100, the ocean along most of California's coast could be 17 to 66 inches higher than in 2000, the report stated. Simultaneously, the entire California coastline south of Cape Mendocino in Humboldt County is subsiding about one millimeter each year due to shifting tectonic plates, according to the study.[26]

California Natural Resources Agency Secretary John Laird maintains that varying sea level rise scenarios reflect the difference between global success and failure in reducing carbon emissions. "If you think we'll be successful in controlling greenhouse gases it will be at low end," he testified during a May 15, 2013, hearing of the Assembly Select Committee on Sea Level Rise and the California Economy. "If we are unsuccessful, it will be at highest end."

Laird told the committee, "At the moment we aren't doing enough to stave off the higher end."

Slow-Moving Emergency

Rising sea levels, often described as a "slow moving emergency," will present an escalating series of challenges that include increasing risk of flooding, inundation, erosion and saltwater intrusion into groundwater aquifers. Two impacts in particular are likely to create extraordinary and politically-charged challenges for the state's legal and governing machinery:

- Combinations of rising tides and more frequent storm surges hold potential to disrupt the California economy, hampering ports and airports, railroads, hospitals, power and water treatment plants, neighborhoods, freeways and transit systems for long periods of time, according to state reports. At least three of the state's international airports – lowland facilities in San Diego, Oakland and San Francisco – face long-term flooding threats to runways

and operations. Many of Silicon Valley's storied technology campuses risk inundation as water levels rise in San Francisco Bay. Many affluent, as well as working-class and lower-income neighborhoods in low-lying coastal areas will be vulnerable. Flooding may spread to facilities that store, generate or use hazardous waste and toxic materials. Sea level rise has implications inland as well, particularly as salt water intrudes into the Sacramento-San Joaquin Delta. Without immense investments to raise and strengthen Delta levees, saltwater from the Pacific Ocean and San Francisco Bay could disrupt freshwater exports to residents of Southern California and reduce the viability of California's agricultural industry.

- Secondly, rising tides will begin to effectively "condemn" individual pieces of private property, converting it to public property as high tide lines that delineate the public trust boundary (according to the California Constitution) move up the beach and onto private real estate. Such conditions portend new legal battles over property rights.

The 2013 California Multi-Hazard Mitigation Plan states: "The rule of thumb for sea level rise is that 50 to 100 feet of beach will be lost for each foot rise in sea level. Thus, sea level rise on the magnitude projected (approximately three to five feet) indicates that California can expect to lose hundreds of feet of shoreline over the next century along its entire coastline." The insurance implications are staggering. Approximately 84 percent of California's 38 million people live in coastal counties exposed to the rising Pacific Ocean. Studies have valued the state's coastal-area infrastructure at more than $1 trillion.[27] "Billions of dollars in state funding for infrastructure and resource management projects are currently being encumbered in areas that are potentially vulnerable to future sea level rise," stated Governor Arnold Schwarzenegger's 2008 Executive Order S-13-08 calling for new research into a rising ocean. A May 2009 Pacific Institute analysis of coastal assets exposed to sea level rise and flooding counted 140 endangered schools and 30 coastal power plants, 35 police and fire stations, 55 healthcare facilities, 28 wastewater plants, 330 hazardous waste facilities or sites, 3,500 miles of roads and highways and 280 miles of railways.[28]

California's local governments are clearly not prepared. California Coastal Commission Executive Director Charles Lester testified to the Commission that approximately two thirds of local governments along the California coastline need to update Local Coastal Programs (LCP) that establish rules for land-use decision-making. "One of the great gaps in the Coastal Act is that there is no requirement to update an LCP; thus,

we have many LCPs that have not been comprehensively updated since they were first approved in the 1980s and early 1990s," he testified before the Commission in August 2013.

A 2013 UCLA School of Law analysis of preparations on California's heavily populated south coast similarly concluded: "Many of Southern California's forty-four coastal county and municipal governments have not yet begun to think about sea level rise in a coordinated and targeted manner."[29]

Backing Away from the Ocean

Fortunately, California has gained experience in managed retreat and getting out of the way gracefully, a process of removing or relocating infrastructure to accommodate the ocean. Four examples described below offer lessons as a rising Pacific Ocean inevitably pressures local and state decision-makers to move roadways, water treatment plants and buildings out of harm's way.

Goleta Beach County Park, Santa Barbara. Winter storms in the late 1990s and early 2000s eroded and damaged Goleta Beach, leading the Coastal Commission to let Santa Barbara County build a temporary retaining rock wall to prevent further damage. In 2009, the commission denied the county's request for another hard structure and asked for a more lasting solution. The county responded in October 2011 with a managed retreat strategy – relocating gas, water and sewer lines, moving a bike path to higher ground and demolishing 107 parking spaces. The county removed the rock wall and restored the area to its natural state.[30]

Surfer's Point, City of Ventura. The Coastal Commission prodded a similar managed retreat strategy in Ventura, where two decades of chronic coastal erosion damaged a popular surfing location. In Ventura, too, the city initially responded with boulders, which intensified erosion of a nearby coastal bike path and public parking lot. When the Coastal Commission denied the city's application for permanent coastal armoring the city proposed a $4.5 million alternative.[31] The project is relocating the disintegrating bike path and 120-space parking lot, preserving public access and restoring a more natural beach habitat. It is expected to provide the area 50 more years of protection.[32]

Pacifica State Beach, San Mateo County. The City of Pacifica, having battled for decades with coastal flooding and erosion, partnered in the early 1990's with the California Coastal Conservancy and the Pacifica Land Trust on a natural solution. The city expanded and enhanced wetlands, while rebuilding sand dunes and restoring the beach. In 2002, the city

allocated $2.2 million to purchase land and remove two vulnerable homes. The new strategy took a decade to complete.[33]

Ocean Beach, San Francisco. Beach erosion also has threatened neighborhoods, roads, parks and sewer and stormwater infrastructure on 3.5 miles of Ocean Beach. When the city's coastal armoring failed to stop the erosion, city, state and federal agencies commissioned the San Francisco Planning and Urban Research Association to find a new solution. The Ocean Beach Master Plan recommended a mix of managed retreat and coastal armoring, moving segments of the Great Highway inland and allowing sand dunes to reclaim the paved road. The plan also recommended coastal armoring to protect the city's sewer and stormwater system on the shoreline. The plan is touted by the Obama Administration as a national model. [34]

The Risks to California's Economic Competitiveness

The Commission heard during its three public hearings that California's economic competiveness hinges on readiness and adequate responses to the variety of climate change impacts just described. Businesses and economic clusters are likely to be on the move as climate threats accumulate, scouting regions and states that are viable, safe and attractive for long-term investment. California, therefore, has much to gain from effective state government preparedness strategies for climate impacts and conversely, much to lose if state and local conditions and responses are perceived as chaotic and unreliable. T. L. Garrett, vice president of the Pacific Merchant Shipping Association, reminded the Commission that 40 percent of containerized imports enter the United States via California ports, many operating near low-lying freeways critical to goods movement and eventually threatened by sea level rise. The Silicon Valley Leadership Group likewise reminded the Commission of possible worst-case business and supply chain scenarios, describing global disruption from lost hard drive production in Thailand during uncontrolled 2011 flooding. Similar climate events in California's future may "demonstrate how business operations and profit margin calculations can be derailed and reversed by extreme and/or persistent weather events," testified Michael Mielke, the group's vice president of environmental policy and programs.

> ***"Cargo has no loyalty. It will find the easiest, most cost-effective path to move through. If California can offer that, great. If not, other gateways will be utilized."***
>
> John McLaurin, President, Pacific Merchant Shipping Association. Capitol Weekly. November 21, 2013.

California's continued success in incubating and maintaining such high-investment business sectors as biotechnology, social media and software, real estate development and export-driven agriculture requires dependable working infrastructure and transportation systems. Employees must be able to get to work. Goods must move uninterrupted by rail and truck. Wastewater must be treated. Hospitals and police and fire stations must not flood or lose power. Cell phones have to work.

The Whiz Kids Below Sea Level

"Facebook is just one of the well-known companies in Silicon Valley's technology mecca that will face the effects of climate change in years ahead. Others located near the water here include Google, Yahoo!, Dell, LinkedIn, Intuit, Intel, Cisco, Citrix and Oracle."

Source: "Can Silicon Valley Adapt to Climate Change?" December 20, 2012. Scientific American. http://www.scientificamerican.com/article/can-silicon-valley-adapt-to-climate-change.

Many of these take-it-for-granted systems broke down after Hurricane Sandy struck the East Coast in October 2012. Storm impacts in New York City alone closed six hospitals and six subway tunnels, cut electrical power to two million customers, disrupted cell phone service for one million users, flooded 88,700 buildings that were home to 23,400 businesses and kept 1.1 million children out of school for a week.[35]

This is hardly something that California wants to imitate. California must remain synonymous with stability, minimizing damage and maintaining conditions for economic growth. Though the state has a long adaptive history to adversity and challenges – rebuilding after earthquakes, navigating the Great Depression and World War II, managing cycles of drought and through it all, absorbing millions of newcomers – climate change and sea level rise, in particular, will represent significant tests for California's business and governing sectors.

State government must build capacity for comprehensive responses that minimize costly and wasteful individual fixes stirred by panic or emotion. Local governments must be effective first responders, providing emergency services, police and fire protection, cleanup and rebuilding. Opportunities will abound in environments driven by uncertainty and crisis for "maladaptation," where decisions go wrong and events spin out of control. In Commission testimony, California climate adaptation researcher and consultant Susanne Moser offered a sobering list of "what ifs?" that could confound and overwhelm government officials. Most dramatic: What if major disruptions begin to occur more frequently, in which one disaster piles upon another and then another with little time to recover, rebuild and return to normal? And what if the magnitude and pace of climate impacts suddenly become greater than anyone anticipated? Ms. Moser suggested the possibility of tipping points and irreversible impacts, unexpected problems and surprises with so many natural and human systems in flux.

Finally, there is the question of planning ahead. Most California cities and counties look out 15 or 20 years when writing a General Plan to guide growth and development. Climate change will require "much longer planning horizons than are traditionally used in decision-making," Ms. Moser stated. The consultant told the Commission, however, "I am not aware of a single governance or legal framework that is in practical use today or is being developed that accounts for this set of challenges."[36]

California's governments have just begun to grapple with the capacity issues, conflicts and complexities that climate change will present. All need new appropriate strategies for protection, accommodation and even managed retreat when it becomes necessary. Yet California's 58 counties, 482 cities and state government have few legal or administrative structures to guide what will need to be done, and then done again and again in cycles of adaptation to changing circumstances, possibly for decades to come. In most government agencies and departments, particularly at the local level, there is little time and few financial resources to look beyond current pressing issues. Climate change adaptation has yet to become a mainstream political or business concern, making it difficult to obtain funding for planning, strategizing or even assessing scientific data for local and regional impacts.

What's Being Done: View from State Government

The Commission recognizes, despite the obstacles and challenges just described, a strong foundation of work already performed throughout state government on climate change adaptation. The state has long been a frontrunner nationally in advancing the understanding of climate impacts, beginning with a 1988 California Energy Commission analysis of climate change directed by the Legislature. The state continues to rank well nationally for its adaptation research and planning, especially when compared with many states that have done little or nothing about climate change, and, in some cases, gone out of their way to deny its existence. In 2013, the National Resources Defense Council counted California among nine states with comprehensive climate adaptation plans. Others include Alaska, Maryland, Massachusetts, New York, Oregon, Pennsylvania, Washington and Wisconsin.[37]

California's emphasis on adaptation is a recent shift, however. The state's signature climate initiatives, produced during the administration of Governor Arnold Schwarzenegger, focused primarily on reducing greenhouse gas emissions with adaptation running a distant second in prominence. Those initiatives included two Executive Orders and a piece of landmark climate legislation signed by the Governor:

- ***Executive Order S-3-05 (2005).*** The order established the state's first greenhouse gas emission reduction targets: back to 2000 levels by 2010, to 1990 levels by 2020, and 80 percent below 1990 levels by 2050. The order also charged the California Environmental Protection Agency (CalEPA) with preparing periodic science reports on potential impacts of climate change on the state's economy. CalEPA assigned leadership of the project to the California Energy Commission and its multi-agency Climate Change Center.

- ***The Global Warming Solutions Act of 2006.*** AB 32 (Chapter 488, Statutes of 2006) set the targets established in the 2005 order into law.
- ***Executive Order S-13-2008 (2008).*** The order called on the National Academy of Sciences to assess anticipated sea level rise off California's coast, and for the California Resources Agency to prepare a climate adaptation strategy for California.

The Governor's executive orders, though primarily centered on reduction of carbon emissions, helped stimulate a flow of adaptation-focused analysis and state guidance to local and regional government agencies. In all, more than 30 major state government reports and others from influential outside institutions such as the Public Policy Institute of California, Pacific Institute and Scripps Institution of Oceanography have concluded that California needs to plan more aggressively for climate change impacts that may be sustained for decades, and find financing tools to address and minimize them. State government's biggest research enterprises include three climate threat assessments conducted by California's academic and research community in 2006, 2009 and 2012 and funded by the California Energy Commission's now-defunct Public Interest Energy Research program. (The state's 2014-2015 budget contains $5 million from the state's Environmental License Plate Fund for a fourth climate threat assessment).[38] The assessments have analyzed a wide range of issues such as institutional barriers to effective climate adaptation, impacts on high-elevation hydropower systems, anticipated public health problems stemming from extreme heat and impacts of sea level rise on key pieces of regional infrastructure.

The Executive Branch: Overseeing Adaptation Strategies

The California Resources Agency conducted a significant exercise in advancing preparedness through its 200-page "California Climate Adaptation Strategy" produced in 2009, and a 289-page draft update, "Safeguarding California, Reducing Climate Risk," released in December 2013. The final version is scheduled to be released in the summer of 2014. The 2009 study, prepared by 12 state agencies, boards, commissions and stakeholders, announced that "climate change is already affecting California" and warned that $2.5 billion of the state's $4 trillion in real estate assets are at risk from sea level rise and wildfires. The 2013 draft update warned more specifically: "State of the art modeling shows that a single extreme winter storm in California could cost on the order of $725 billion – with total direct property losses of nearly $400 billion and devastating impacts to California's people, economy and natural resources."

The process that produced the 2009 adaptation strategy and 2013 update, however, has largely been confined within state government agencies. Testimony during Commission hearings disclosed a lack of widespread participation by the general public or the private sector in adaptation deliberations. Representatives of local governments and other regional stakeholders also complained during Commission interviews and hearings of feeling left out of the state's process or not being aware of it until findings were released. The strategies, as a result, lack a true statewide view incorporating the advanced thinking and preparations by local government and the business sector.

More, the Safeguarding California plan, while comprehensive and forward-looking, is non-binding on state agencies. It requires no specific state actions to advance climate adaptation. Ann Chan, deputy secretary for climate change with the Natural Resources Agency, testified to the Commission in August 2013, that the plan "is meant to be a policy guidance document for state decision-makers." On January 15, 2014, Ms. Chan repeated to the California Water Commission that it establishes no specific adaptation policy for state agencies.

The plan, then, remains at present merely suggestive as an adaptation tool for the state, and with its length and advisory-only focus, is likely to go largely unread and unheeded in busy local government, private sector or non-governmental organization offices statewide. As will be described

Safeguarding California Strategies

The draft Safeguarding California plan outlines seven broad strategies to help the state respond to climate impacts. Among them:

- All core functions of government must make the risks Californians face from a changing climate an integral part of their activities.
- Provide risk reduction measures for California's most vulnerable populations.
- Identify significant and sustainable funding sources for investments that reduce climate risks, human loss and disaster spending.
- Support continued climate research and data tools to inform policy and risk reduction activities.
- Maximize returns on investments by prioritizing projects that produce multiple benefits and promote sustainable stewardship of California's resources.
- Prioritize climate risk communication, education and outreach efforts to build understanding among all Californians.
- Promote collaborative and iterative processes for crafting and refining climate risk management strategies.

Source: California Natural Resources Agency. December 2013. "Safeguarding California: Reducing Climate Risk." An Update to the 2009 California Climate Adaptation Strategy. Public Draft. http://resources.ca.gov/climate_adaptation/docs/Safeguarding_California_Public_Draft_Dec-10.pdf.

shortly, the major metropolitan areas of California are already addressing adaptation issues independently of the state, and in many cases are advancing faster with coalitions that seek the wider insights of multiple public and private sectors.

The Climate Action Team

The state's Climate Action Team (CAT) likewise can be perceived at this juncture as a structure more for assessing adaptation options than undertaking concrete actions, implementing defensive investments or answering the question on the minds of many local officials: "What should I do?" Multiple state government departments under the auspices of the Climate Action Team are conducting planning and research activities in their particular areas of expertise. As master coordinator, the CAT is headed by the secretary of the Environmental Protection Agency and 16 other agency secretaries and department directors.

Climate Action Team Representatives

State government boards, agencies, departments and commissions on the Climate Action Team include:

- Air Resources Board
- State Water Resources Control Board
- Business, Consumer Services and Housing Agency
- Environmental Protection Agency
- Government Operations Agency
- Health and Human Services Agency
- Natural Resources Agency
- Transportation Agency
- Department of Fish and Wildlife
- Department of Food and Agriculture
- Department of Forestry and Fire Protection
- Department of Resources Recycling and Recovery
- Department of Transportation
- Department of Water Resources
- Public Utilities Commission
- Energy Commission
- Governor's Office of Planning and Research

Source: State of California. 2014. Climate Action Team. http://www.climatechange.ca.gov/climate_action_team.

The group process, as has been typical of the state's approach to date, tilts most heavily toward curbing greenhouse gas emissions, while secondarily preparing the state for climate impacts. It consists of self-described "Co-CATS" in the areas of public health, agriculture, biodiversity, research, coastal and ocean climate, forestry, land use and infrastructure, state government, water and energy. The subgroups meet largely among themselves, again confining the process largely within state government circles, and also with the larger climate action team group to analyze new findings, review reports and periodically assess the changing nature of climate forecasts and threats. Visitors to the Climate Action Team website also find that much of the material and reports are dated or focused largely on the state's AB 32 greenhouse gas reduction efforts,

with less emphasis on adaptation to the actual impacts of climate change.

The Commission heard more criticisms from outsiders in local government and the private sector that the Climate Action Team process, too, tends to be insular with state officials talking mostly with their peers in other state agencies. The Climate Action Team, like the official adaptation strategy process, could benefit from obtaining more perspective outside the state government purview. The Commission heard suggestions that the Climate Action Team should provide seats for local and regional government representatives who can offer perspective in advance on how state adaptation policies will or will not work "on the ground."

Recent legislation by the State of Hawaii offers a fresh example of how California's adaptation efforts within the Resources Agency and Climate Action Team might include more outside interests and widen the perspective. In June 2014, Governor Neil Abercrombie signed House Bill 1714 to create an "Interagency Climate Council" responsible for implementing state policy "to address the effects of climate change through 2050 to protect the state's economy, health, environment and way of life."

The council will include 11 executive branch members and legislative committee chairs, but also invites participation from 19 others who include the commander of the United States Pacific Command, four county planning directors, the president of the University of Hawaii and two specialist deans, the regional federal administrators of the Federal Emergency Management Agency, Environmental Protection Agency, Army Corps of Engineers, Department of Energy and Department of Agriculture, as well as a representative of "any other agency or organization related to climate change that the coordinator designates as appropriate."[39]

Agency and Department Initiatives

Alongside the larger state efforts and strategies just described, individual state departments also have conducted their own initiatives to more deeply embed climate change adaptation into everyday policy and operations. These efforts, while laudable, remain largely in the emerging stage and also lack coordination with other departments.

The Department of Water Resources, for instance, is building climate change issues into its successive statewide water plans and Integrated Regional Water Management strategies. The Department of Fish and Wildlife is addressing climate change impacts in revising its Wildlife

Action Plan. (The department also has launched California state government's first "Climate College," a series of classes to provide department managers and staffers a wider climate context for their evolving work). The Governor's Office of Emergency Services has increasingly concentrated on climate impacts in its 2007, 2010 and 2013, statewide hazard mitigation plans.

In addition, state government agencies have produced an extensive series of guidance tools and documents, both for their own staffs, and for local and regional governments, to begin comprehending and addressing climate impacts in areas from land use to transportation to coping with extreme heat. The California Department of Transportation (Caltrans), for instance, is integrating guidance from other agencies on sea level rise into planning its infrastructure. The Natural Resources Agency and California Energy Commission have jointly released Cal-Adapt, an

Current State Efforts to Help Regions Begin Planning

State government already offers climate change adaption guidance to local and regional agencies and has a handful of small grant programs that also contribute to readiness planning efforts.

- The "California Climate Adaptation Planning Guide" issued by the Natural Resources Agency and California Emergency Management Agency (now Governor's Office of Emergency Services) in September 2012 introduces a step-by-step process for local governments to assess their vulnerabilities and begin developing an adaptation strategy. http://resources.ca.gov/climate_adaptation/local_government/adaptation_policy_guide.html.
- "Addressing Climate Change Adaptation in Regional Transportation Plans" issued by Caltrans in February 2013 tells the state's metropolitan planning organizations how to factor climate change into long-range transportation plans. http://www.dot.ca.gov/hq/tpp/offices/orip/climate_change/documents/FR3_CA_Climate_Change_Adaptation_Guide_2013-02-26_.pdf.
- The state's Cal-Adapt website provides visualization tools and data to show how climate change affects local areas. http://cal-adapt.org.
- The first update of California's "General Plan Guidelines" since 2003, expected to be released in 2014, will show for the first time how to build climate change adaptation into the long-range growth plans of cities and counties.
- The Ocean Protection Council, a division of the California Natural Resources Agency, is awarding $2.5 million during 2013 and 2014 to help coastal communities update Local Coastal Programs (LCPs), the basic planning tool to guide coastal development in cities and counties. (Two-thirds of LCPs are outdated, according to Commission testimony from Charles Lester, executive director of the California Coastal Commission). Individual grants will range from $50,000 to $250,000, with priority given to communities that emphasize use of natural, rather than hard, infrastructure. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/LCP2013/LCP_SLR_Program_Announcement_FINAL.pdf.
- The Coastal Commission also has been allocated an additional $6 million during the 2014-2015 and 2015-2016 fiscal years to work with local governments to accelerate completion and updates of LCPs. These updates will include planning for climate change adaption and sea level rise.

Internet tool that helps government agencies, city and county planners and the public identify potential climate change risks in specific areas throughout the state.

The California Strategic Growth Council, a cabinet-level body that aims to integrate state government planning priorities into infrastructure funding, has awarded several million dollars from Proposition 84 funds to cities and counties to prepare climate action plans. Some of those are beginning to include a focus on adaptation. The Governor's Office of Planning and Research (OPR), too, anticipates releasing its updated General Plan Guidelines in 2014, with a renewed emphasis on building climate change adaptation into local governments' long-term blueprints for development.

The California Insurance Commissioner has likewise led statewide and national efforts that require insurance companies doing business in California and several other states to disclose their greenhouse gas emission reduction and climate impact adaptation strategies. Commissioner Dave Jones, in a June 28, 2013, forum in Pasadena, said that 23 insurance companies doing business in California have a comprehensive climate change strategy in place, while 161 other insurers doing business in the state still lack one. In Commission testimony, Ms. Moser told the Commission the disclosure requirements are "an important element in raising awareness of climate risks in both the private and public sectors and in building motivation for risk-smart investment and development."

The Legislature Begins to Respond

In general, the Legislature has not yet focused on climate change adaptation in equal measure to its work on reducing greenhouse gas emissions that contribute to climate change. Nor has it developed a comprehensive approach for the state's responses. However, the Legislature conducted its first comprehensive assessment of threats to California from sea level rise with four hearings in 2013 and 2014 by the Assembly Select Committee on Sea Level Rise and the California Economy. The select committee process produced its first bill, AB 2516, which proposes a statewide Planning for Sea Level Rise Database that is accessible on the Natural Resources Agency website. The bill passed in the Assembly in May 2014 and is now under consideration by the Senate Appropriations Committee, following approval by the Senate Natural Resources and Water Committee. The bill's author, Assemblymember Richard Gordon of San Mateo, states that the database "would serve as a single source of information that portrays where California is in terms of preparing for, and adapting to sea level rise." Assemblymember Gordon stated that the select committee learned that information and guidance

is currently "not centrally located, but found piecemeal among many entities and agencies."

One of the Legislature's first climate adaptation bills, Senate Bill 1066, passed and signed into law in 2010, requires the California Coastal Conservancy to address current and potential impacts of climate change on coastal resources. The bill, carried by Senator Ted Lieu, authorized the conservancy to award grants to public agencies and nonprofit organizations for activities that protect the coast from climate change. In January 2014, the conservancy allocated approximately $3 million in "Climate Ready" grants to 20 coastal jurisdictions and nonprofit groups. According to the conservancy, "Ten of the projects are geared to helping shoreline areas adapt to sea level rise and prevent the destruction of homes, businesses, roadways, airports, sewage treatment plants, and other public facilities. A Los Angeles project will examine ways to protect its iconic beaches from rising seas and storm surges. Five projects address changing rainfall patterns and expected water shortages. They will identify how storm water may be captured and stored for later use, enabling urban areas and farming operations to become less reliant on imported water and reducing storm flows that pollute waterways and the ocean."[40]

A second climate impact bill passed and signed into law in 2012, AB 296 by Assemblymember Nancy Skinner, required the California Environmental Protection Agency to develop a standard definition of "urban heat island effect." It also required Caltrans to use that definition to develop a standard specification for sustainable or cool pavements that can be used to reduce the urban heat island effect.

The Legislature in 2013 passed a third climate adaptation bill, AB 691, by Assemblymember Al Muratsuchi, requiring that local trustees of California's public trust land submit assessments to the State Lands Commission, explaining how they propose to address sea level rise on their facilities in the years 2030, 2050 and 2100. The bill, signed into law by Governor Brown, applies to eight state ports in Los Angeles, Long Beach, San Diego, San Francisco, Oakland, Richmond, Benicia and Eureka and requires that assessments be submitted by July 1, 2019.

Moving Beyond Planning to Action

Collectively, these actions by state government provide a foundation for future action. Yet the Commission learned during its hearings that much, if not most, of this work in the executive and legislative branches, still consists of broad vulnerability assessments and recommendations for further study, rather than implementation of solutions. This is not surprising, given the uncertain nature and timing of the climate threat.

Indeed, it is largely the norm globally, according to the Intergovernmental Panel on Climate Change (IPCC), an authoritative body of global scientists. In a March 2014 report on climate adaptation globally, the IPCC stated, "Most assessments of adaptation have been restricted to impacts, vulnerability, and adaptation planning, with very few assessing the processes of implementation or the effects of adaptation actions."[41]

But the lack of specifics about what leaders should actually be doing – beyond learning about the climate threat and determining their exposure – has repeatedly surfaced during the Commission's study process. Witnesses and others in interviews told the Commission that the state has become good at telling people they may be in danger. But it has not been able to define that danger very well at the level of four-square blocks in a particular city. It has not been able to provide the newest standardized, authoritative and science-based information on which a city manager might base decisions. In short, it has largely been unable to tell Californians what to do about the danger they face. This inability is key to understanding much of the action being taken in response at the local and regional level in California.

Regions Take Matters into Their Own Hands

Throughout the large metropolitan regions that house approximately 80 percent of California's population, mayors and county supervisors, transit operators, flood control agencies, utilities, community foundations and business and nonprofit organizations also have begun organizing. The Commission's October 24, 2013, hearing reviewed what is happening on the ground – primarily in Los Angeles, San Diego, the Bay Area and Sacramento, but also in smaller cities and rural areas – to prepare for disruptive climate events. The Commission found great encouragement in the range of adaptation work occurring beyond the state government efforts. Much of this regional work is funded by Michigan's Kresge Foundation, the top financial backer for regional climate adaptation efforts in California.[42]

"One of the interesting things you see here in the state is emergence of regional adaptation planning efforts," Ms. Moser told the Commission at its August 2013 hearing. "There is a regional identity that drives people," she said. "People have a commitment to the LA region, to the San Diego region, to San Francisco Bay. That's what unites them. Having a regionally coherent approach is probably the most useful one and most economical one, and I think, also tapping into peoples' regional pride. Neighborhoods, communities and regions. That's going to be essential."

California's 482 incorporated cities and 58 counties have unique responsibilities and powers that differ from those of state government.

They are first responders, bearing the heaviest burdens of emergency response and recovery during disasters and disruption. Though local governments receive aid from the state and federal government during disasters, the Incident Command System that governs large-scale emergencies assigns command responsibility to local officials. Cities and counties also have broad authority over land use, determining what gets permitted and built – and where. They have the prime responsibility to plan, finance and build local infrastructure such as streets, sewers and wastewater treatment plants. Meanwhile, independent special districts – approximately 2,300 statewide, according to the California Special Districts Association – cross many city and county lines with their own powers to provide flood control, transit services, parks and recreation, clean air and safe drinking water. Adding yet more complication, councils of government and metropolitan planning organizations also guide transportation investments across city, county and regional lines. These sprawling, diffused networks of competing and shared interests, steered by an endless variety of political and governing cultures, occupy the front lines of climate change adaptation in California. Collectively, it

The Big Metros Sponsor Groundbreaking Climate Analysis

California's academic, research and government sectors are producing groundbreaking and model studies of climate change impacts at the regional and neighborhood scale. Four examples:

San Francisco Bay Area: The groundbreaking $1.6 million Adapting to Rising Tides (ART) analysis looks at probable impacts to 26 miles of intensely-developed Alameda County shoreline. The three-year project finalized in 2013 is a joint effort of a state agency, the San Francisco Bay Conservation and Development Commission and the U.S. National Oceanic and Atmospheric Administration. The ART project stands out as California's most detailed regional analysis yet of climate change impacts, and has been suggested as a model that the state can fund for other regions. http://www.adaptingtorisingtides.org.

San Diego: The 2012 "Sea Level Rise Adaptation Strategy for San Diego Bay" considers impacts of a rising ocean on assets critical to the region's economy. The San Diego Foundation, which played a unique role in convening regional interests and investing $2 million to address climate change adaptation in San Diego County, funded this model analysis of risks and defense strategies. http://www.icleiusa.org/static/San_Diego_Bay_SLR_Adaptation_Strategy_Complete.pdf.

Los Angeles: The "Sea Level Rise Vulnerability Study for the City of Los Angeles" examines in detail which neighborhoods and facilities will bear the brunt of increased flooding. The study by the University of Southern California offers the most detailed analysis yet of risk to Los Angeles infrastructure (two wastewater treatment plants, two power plants and a port) and coastal neighborhoods. The study also assesses specific adaptive capacity at each of these sites. http://www.usc.edu/org/seagrant/research/sea_level_rise_vulnerability.html.

Los Angeles: The "Climate Change in the Los Angeles Region" project offers one of the world's most advanced looks at how rising temperatures will variously impact people at the neighborhood level. Most importantly, the study determined that reductions in greenhouse gas emissions will provide few climate benefits by 2050, but clearly make a difference by 2100. Studies conducted by the University of California, Los Angeles, analyze rising temperatures, reduced snowpack, changing rainfall patterns, diminishing Santa Ana winds and greater wildfire dangers. http://c-change.la/temperature.

will be their responsibility to protect Californians and their local economies, as well as all their built and natural environments from the vagaries of extreme weather.

Commission testimony and interviews with regional leaders portrayed numerous distinct climate adaptation approaches being taken within California's four largest metropolitan regions. All are at different stages in formulating strategies and preparations and use varying labels of adaptation, preparedness, safeguarding, readiness and resilience. The Commission learned that many of California's regional efforts stand up well compared to those in other states, and appear to be near or at the forefront of climate change adaptation. But it also is worth noting that nearly all the regional initiatives to be described shortly remain in the research, organizational and planning stages. Many are easily described as first steps and efforts by leaders to simply get their arms around the problem. To date, few concrete, long-term actionable climate defenses have been or are being implemented in California's metropolitan and rural regions.

Los Angeles

Los Angeles County, home to more than 10 million people in 88 cities, has the largest number of residents in the state who will be exposed to the detrimental impacts of climate change.[43] Nowhere in California is a large population so vulnerable, fronting a rising ocean and supplied by distant sources of water and power. Until recently, the region's academic, government and nonprofit sectors have focused primarily on reducing carbon emissions. Los Angeles, however, is becoming a model for developing science-based information regarding heat, snowfall, wildfire and sea level rise to narrow the uncertainties of climate change at the local level. In early 2014, the City of Los Angeles and the University of Southern California (USC) greatly expanded the city's understanding of its adaptation challenges, reporting on potential detailed impacts of sea level rise on coastal neighborhoods and key pieces of infrastructure. During the next two years USC researchers plan on extending the assessment of sea level rise for all of Los Angeles County.

A key piece of the emerging adaptation infrastructure in Los Angeles County is the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC), founded in 2007 and housed at the UCLA Institute of the Environment and Sustainability. Guided by a 27-member steering committee, LARC provides an important forum for widespread regional interaction by academics, government officials and stakeholders. The collaborative holds responsibility for developing a countywide climate action plan called "A Greater LA: the Framework for Regional Climate

Action and Sustainability."[44] Though the plan aims primarily to reduce greenhouse gas emissions, it also will prepare the region to address climate impacts. Financial support includes a $1 million three-year grant from the state government's Strategic Growth Council to develop, in partnership with the Los Angeles Metropolitan Transportation Authority, a climate change adaptation framework for Los Angeles County.

The LARC collaborative, however, has no legal authority to compel action or planning in a county where skills to address climate adaptation vary widely. In October 24, 2013, testimony to the Commission, LARC Managing Director Krista Kline said, "Some local jurisdictions are aware of the need for adaption planning, and have the knowledge, capacity and other tools to undertake such an effort. However, this level of understanding and ability is unfortunately, not the prevailing standard in the LA region." Ms. Kline told the Commission that LARC's work remains "limited to building the capacity of local jurisdictions to undertake climate change."

The nonprofit organization, Climate Resolve, also is highly influential in regional adaptation efforts, and describes itself as the lone organization focused exclusively on preparing Los Angeles for climate impacts expected by 2050.[45] The organization communicates climate science to the public and advocates for implementing practical solutions such as cool roofs, cool pavement and streetscapes to lower the urban heat island effect in a county where 40 percent of the land mass is covered by pavement and another 20 percent is covered by rooftops.[46]

Jonathan Parfrey, executive director of Climate Resolve, a founding member of LARC and commissioner of the Los Angeles Department of Water and Power during the administration of Mayor Antonio Villaraigosa, told the Commission that revitalizing local supplies in a region that imports 89 percent of its water and depends heavily on distant electricity sources must be a top priority in building climate resiliency. "More (electrical) power at the local level is more resilient," he said. Mr. Parfrey noted that the Los Angeles Department of Water and Power aims to provide 37 percent of its water locally by 2035, an initiative he said is likely to cost $10 billion. "This is not virtuous. This is necessary," he told the Commission. "This is an existential crisis that demands action."

During its hearing process, the Commission learned that the massive Los Angeles basin continues to lack a true region-wide focus on adaptation however. Orange, Riverside and San Bernardino counties, which contain seven million residents in addition to the 10 million who live in Los Angeles County, are not involved in LARC and, to the Commission's

knowledge, have no adaptation frameworks or similar climate collaboratives. Conversations with climate adaptation leaders statewide suggest that political cultures in Orange, Riverside and San Bernardino counties have not ranked climate adaptation as a priority equal to that in neighboring Los Angeles County.

San Francisco Bay Area

Among California's four major metropolitan regions, the nine-county San Francisco Bay Area appears to be the most advanced in considering the impacts of climate change and laying groundwork to govern a response. The San Francisco Bay Conservation and Development Commission (BCDC), a state agency that oversees the regional waterfront, has provided substantial leadership in the region. The Bay Area is unique in having a full-time climate strategist embedded within the regional governing structure, and to date boasts more than 90 individual climate change adaptation initiatives.[47] Typically of California, however, most are in early stages of addressing climate change threats. A 2012 analysis of Bay Area initiatives by the California Energy Commission's California Climate Change Center, stated, "So far those working on adaptation seem to be mostly engaged in building their own adaptive capacity and overcoming these hurdles rather than making major structure, policy or management changes."[48]

The principal threat to the Bay Area's 7.1 million residents, 101 incorporated cities and clusters of the world's most successful technology companies is sea level rise. "The economic value of Bay Area shoreline development (buildings and their contents) at risk from a 55-inch rise in sea level is estimated at $62 billion," the BCDC stated in 2011.[49] But other threats include rising temperatures and declining growing conditions for winemakers, a diminishing snowpack for Sierra Nevada reservoirs that supply the region's drinking water and growth in energy demand, especially in the warmer East Bay. Bruce Riordan, a climate change strategist for the San Francisco-based Joint Policy Committee (the coordinating body for planning efforts by the BCDC, Association of Bay Area Governments, Bay Area Air Quality Management District and Metropolitan Transportation Commission) testified to the Commission on October 24, 2013, that an equally dangerous climate threat in the Bay Area is political gridlock within an extensive proliferation of local and regional agencies able to checkmate one another. "We're good at stopping things. We're really good at keeping things from happening," Mr. Riordan said. He told the Commission that governance is the biggest necessary fix for confronting climate change. "How do you get things to happen in six months?"

Like Los Angeles, the Bay Area has a regional climate collaborative, the Bay Area Climate & Energy Resilience Project, founded in 2011. The collaborative of 100 public, private and nonprofit stakeholders functions as a convening hub and backbone to coordinate and support cities, counties and non-governmental organizations that are doing adaptation planning and implementing projects.[50]

The Bay Area stands alone in California in having a state agency, the BCDC, as a lead player in regional climate change adaptation. The commission, formed in 1965 as a temporary state agency to regulate the rapid filling of San Francisco Bay for development, became a permanent agency in 1969 and remains formidable as the federally-designated state coastal management agency for the San Francisco Bay segment of the California coastal zone. The BCDC is driving a large-scale pilot risk assessment of the Alameda County shoreline for sea level rise and a regional sea level rise strategy that is expected to be completed near the end of this decade. The BCDC in 2011 amended the San Francisco Bay Plan, adopting rules requiring developers to accommodate new sea level

One Answer: A $75 Billion Tidal Barrage at the Golden Gate

Rising sea level is a major threat in San Francisco Bay with more than 200 square miles of land and development worth more than $100 billion at risk. One adaptation scenario would construct hundreds of miles of coastal armor such as levees, dikes and seawalls along the shoreline. A stunning alternative still making the rounds and presented years ago by the San Francisco Bay Conservation and Development Commission (BCDC) would build a dam (barrage) across the Golden Gate. The tidal barrage would manage both inflow and outflow of the tides in the Bay.

In 2007, BCDC studied the advantages and disadvantages of constructing a barrage at the mouth of the Golden Gate. The BCDC cited cost as a primary disadvantage. Estimates placed the price at double or triple the cost of building the Three Gorges Dam in China (which cost more than $25 billion). Moreover, a barrage would be a more expensive protection strategy than smaller-scale adaptation projects of building coastal armor and reconstructing infrastructure.

In addition, the BCDC analysis revealed that barrages are ecologically damaging, and would affect the Bay's salinity, sedimentation, wetlands, wildlife and endangered species.

In 2009, the BCDC organized a follow-up "Rising Tides" design competition for possible adaptation strategies to sea-level rise in the San Francisco Bay. The competition sought innovative solutions to various design challenges that rising sea levels impose on the Bay. Some of the challenges include retrofitting existing shoreline infrastructure, planning for development of new communities in areas susceptible to inundation, providing flood protection to wetlands and anticipating a new shoreline.

Teams submitted 130 entries from 18 countries. Six teams were announced as winners, splitting a cash prize of $25,000. Among winners were Faulders Studio's laser light barrier that measures the projected sea level rise, Kuth Ranieri Architects' ventilated levee to balance the sea/bay water levels and Skidmore, Owings & Merrill's proposal to construct a smart membrane under the Golden Gate Bridge.

Sources: San Francisco Bay Conservation and Development Commission. November 20, 2007." Analysis of a Tidal Barrage at the Golden Gate." http://www.bcdc.ca.gov/pdf/planning/Golden_Gate_Dam_Report.pdfA. Also, San Francisco Bay Conservation and Development Commission. 2009. "Rising Tides Competition." http://www.risingtidescompetition.com/risingtides/Home.html.

rise projections on shoreline projects. In September 2013, the BCDC, for instance, approved Phoenix Commons, a senior housing project on the Oakland shoreline, featuring a public promenade designed to cope with high-water levels expected by 2050. The developer, Alameda Elder Communities, called it the "first development project on the Bay to comply with new regulations concerning the rise of water levels due to global warming."[51]

San Diego

The San Diego region, with its 3.1 million residents stands out as a model in convening and connecting the philanthropic, business, academic and nonprofit sectors with government policymakers to address climate change. Credit is due to a 2009 call for community action put forth by the San Diego Foundation, a regional community foundation with $562 million in assets.[52] The foundation, established in 1975, has played a unique role in climate change adaptation, convening regional stakeholders while leading and funding the planning and research that distinguishes San Diego's efforts. The foundation patterned its "regional wake-up call" on a similar "Focus 2050" study in King County, Washington, and billed it as the "first comprehensive regional assessment of climate change impacts to San Diego County." The foundation's January 2013 progress report stated that half the region's 19 local governments have developed climate action plans to reduce carbon emissions that contribute to global warming and also "deal with the local risks posed by climate change."[53]

"Climate mitigation to me is a sprint. We're all rushing to reduce greenhouse gases as quickly as possible. But I think when you talk about climate adaptation it's a marathon. We're looking to do small incremental changes now that in 50 or 100 years will have big returns."

Brendan Reed, Environmental Resources Manager, City of Chula Vista. "Impacts and Adaptation Local Government Conference." Los Angeles. April 9, 2012.

The risks of sea level rise, water and energy shortages and wildfires are substantial in a region dependent upon waterfront tourism, a thriving biotech industry, academic institutions, port facilities and U.S. military presence. In 2012, San Diego regional leaders banded together into the Climate Collaborative, a "regional forum for public agencies to share expertise and leverage resources to facilitate climate action planning." The collaborative began with significant investment from San Diego Gas & Electric and a steering committee consisting of the City of San Diego, County of San Diego, Port of San Diego, San Diego Association of Governments, San Diego Gas & Electric, University of San Diego and City of Chula Vista.

Emily Young, vice president, environment initiatives, at the San Diego Foundation, testified to the Commission that the foundation began to look at climate change adaptation in 2005 as a way to protect its investments. The foundation's Environment Program has granted more than $7 million to environmental organizations and programs in San Diego County and leveraged millions more in public and private funding to conserve 28,000 acres of open space. "We realized that everything we

were protecting was threatened by climate change," Ms. Young said. "We had no good data regionally."

The foundation – through its Climate Initiative – has since invested approximately $2 million to address climate change in San Diego County and supported a dozen regional climate research projects. The San Diego Foundation convened quarterly meetings of regional stakeholders at its facilities and kept a scorecard of achievements that now include formation of the Climate Collaborative and continuing work on climate adaptation plans and strategies at several cities, the port, the county water authority and regional association of governments.

The region's signature study, the January 2012 "Sea Level Rise Adaptation Strategy for San Diego Bay," found that a rising ocean combined with storm surges could regularly inundate shoreline parks and residential buildings and make San Diego International Airport nearly unusable. The San Diego Foundation prepared the study with the International Council for Local Environmental Initiatives (ICLEI) Local Governments for Sustainability USA, an Oakland-based nonprofit that helps governments achieve sustainability, climate protection and clean energy goals. The year-long process engaged a wide number of regional stakeholders and technical advisors to produce one of the nation's first regional strategies for coping with higher water in a maritime environment. Guiding the process was a steering committee consisting of the cities of San Diego, Chula Vista, Coronado, Imperial Beach and National City, and the San Diego Unified Port District and San Diego Regional Airport Authority.

The strategy contains two main components: an assessment that evaluates impacts of rising water on community assets and infrastructure, and broad and targeted recommendations for defending them. Many identified vulnerabilities are the same as those experienced in New York City during Hurricane Sandy in October 2012: flooding of hazardous waste sites, overwhelmed sewer systems, high-volume effluent discharge into the bay, disruption of the electrical grid, flooded fire stations and inability to get to or use the regional airport. Most impacts are expected to some degree by 2050 and to a far larger and more dangerous scale by 2100.

By 2100, high water at San Diego International Airport is likely to close Harbor Drive, the only route to the airport, and flood the airport's lone runway. The report describes the unthinkable for a large metropolitan region dependent on air travel: "Flooding as described in the 2100 scenarios would likely necessitate closure of the facility on a regular basis. The risk of regular closure and potential damage to equipment would strongly deter airlines from operating at the facility"

and the region "would not have a functional commercial passenger and air cargo airport to meet the needs of a growing metropolitan area."

Sacramento

No American city might be considered more vulnerable to the flooding disaster associated with Hurricane Katrina in 2005 than the home of California's Capitol, Sacramento. The Sacramento region, home to more than two million people in six counties, earned a media definition in 2006 as "the scariest spot in the country" after New Orleans.[54] Assistant Deputy Director John Andrew of the California Department of Water Resources confirmed the assessment during a Natural Resources Agency climate adaptation forum in September 2013, saying, "Sacramento has the highest flood risk of any city in the entire country." By 2050, Sacramento also may "experience more than 100 additional days of temperatures above 95° Fahrenheit each year."[55] Such prospects for floods, heat, drought and energy demand prompted an inaugural September 12, 2013, gathering of nearly 50 regional leaders to begin visualizing and organizing preparedness.

The creation of the Capital Region Climate Readiness Collaborative represents the newest and fourth regional climate change collaborative in California. Steering the collaborative are the Sacramento Area Council of Governments, Local Government Commission, UC Davis Policy Institute for Energy, Environment and the Economy, Sacramento Municipal Utility District, Pacific Gas and Electric Company, Sacramento Metropolitan Air Quality Management District and Greenwise Joint Ventures, an economic development initiative focused on a strong green economy. Sacramento provides an example of regions just beginning to grapple with what might happen as a result of climate change and how it might roil their economies. The collaborative includes representatives from the business and agricultural communities, elected officials and local government staff, electrical and gas utilities, academics and civic and environmental organizations.

Organizing as One: "You're at the Table or You're on the Menu."

Importantly, the four collaboratives formed by these regions since 2007 to help leaders determine vulnerabilities and needs, and discuss how they will govern themselves when the going gets tougher, also have collectively organized at the state level. In conjunction with the Governor's Office of Planning and Research (OPR) they formed a single statewide collaborative in 2012, the Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), to present a unified voice to state government for their regional needs.

The statewide ARCCA collaborative meets quarterly as an informal network of regional leaders and public agency staffs to discuss developments, and share ideas and best practices. The OPR is an ex-officio member of ARCCA and views it, according to Michael McCormick, an OPR senior planner and local and regional affairs advisor, as a one-stop contact for information and conversations related to state-local climate change adaptation. In the founding language of ARCCA, regions view their statewide collaborative as a "mechanism for working collectively with state agencies to create a formal partnership that will make the most efficient use of our limited resources and streamline state and regional adaptation assistance to local governments."

The language hints at the difficulties regions have encountered in being largely left out of state government's climate adaptation work. Principal founders of the regional Sacramento adaptation collaborative – Kate Meis, executive director of the Local Government Commission, and Larry Greene, executive director of the Sacramento Metropolitan Air Quality Management District – contended that state agencies have conducted strategizing and planning efforts for years without inviting regional voices to the table. "We were surprised by how much the state is doing," said Mr. Greene to several dozen participants at the inaugural Sacramento meeting in September 2013. "You're either at the table or you're on the menu," he said. "We want to shape decisions made at the state and local level to our benefit." Ms. Meis and Mr. Greene suggested to the Commission that the state consider adding regional participants to its Climate Action Team. More regional players, they said, could provide valuable input in the formative stages of crafting statewide adaptation policy and importantly, help the state "sell" those more inclusive policies back home.

Elsewhere in America: Three State Strategies

The great variety of emerging adaptation efforts inside California state government and its major metropolitan regions led the Commission to examine adaptation strategies and actions taken in other states. The Commission focused particularly on Florida, Oregon and Washington, three coastal states with challenges similar to those of California:

The Southeast Florida Climate Compact

Low-lying Southeast Florida is often listed among the nation's most at-risk regions for sea level rise, with some predicting that Miami could nearly disappear by 2100.[56] Yet in October 2012, four Southeast Florida counties – Palm Beach, Broward, Miami-Dade, and Monroe – produced what many consider a model for "voluntary" multi-jurisdictional

governance for climate adaptation.[57] It is called the "Southeast Florida Regional Climate Action Plan."[58]

California has nothing like it. The plan stems from a 2009 regional climate leadership summit and a challenge to build an adaptation plan to serve all four counties and their 100 cities. Rather than making each county conduct its own research and planning for sea level rise, the four did it jointly under auspices of a Southeast Florida Climate Compact.

Importantly, the climate action plan contains no adaptation mandates, which proved key to gaining public and political support. The plan offers a framework of policies, projects and solutions that local governments *may* adopt or use based on their own interests or vision. Participating counties agreed and understood that each city or county would act differently within the larger regional framework.[59] The arrangement recognized a diversity of approaches, producing forward motion where adaptation might otherwise have stalled due to infighting and the kind of agency checkmating common in California. Jurisdictions are free to adopt individual initiatives at their own pace and within a context that best suits their needs.[60]

Oregon Climate Change Adaptation Framework

Oregon faces many of the same climate challenges as California: extreme heat, reduced snowpack, worsening wildfire and greater coastal erosion from sea level rise. The state is preparing for these impacts through its December 2010 "Climate Change Adaption Framework," a blueprint for agencies to identify their areas of authority, strategies, research and financial resources.

The 2010 framework outlined 11 key climate risks expected within three to five decades and classified them into three-levels: very likely, likely and more likely than not. The Oregon framework exemplifies a "cost-benefit" approach to prioritize adaptation measures. The original framework identified 119 possible short-term actions, but state financial constraints forced a narrowing to 20 priority short-term and low-cost actions. Among them are building capacity in the public health system, improving water storage capacity and conservation, identifying better ways to manage ecosystems for resilience and improving the state's capability to quickly assess and fix damaged transportation infrastructure.

The Oregon framework, initially prepared by state agencies and partners within Oregon's university system, has subsequently become a foundation for local and regional governments to plan more specifically. The state considers the 2010 climate change adaptation framework a

first step for continued development of strategies to improve Oregon's adaptive capacity.[61]

Washington Integrated Climate Response Strategy

Washington has long been at the forefront of climate change adaptation nationally. In 2007, King County produced one of earliest regional climate action plans to curb carbon emissions and begin preparing for climate impacts. Former Governor Christine Gregoire took the idea statewide in 2009, directing the state Department of Ecology to prepare a climate adaptation strategy in collaboration with local state and federal agencies.

Within three years the state departments of Ecology, Agriculture, Commerce, Fish and Wildlife, Health, Natural Resources and Transportation released a unique statewide plan – "Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy."

The new strategy adopts a "no regrets" approach to addressing climate change.[62] No regrets adaptation refers to decisions with net benefits over an entire range of climate and associated impacts.[63] In employing this approach, Washington will advance public health, sustainable growth and economic competitiveness within its climate change strategy, producing a "win" no matter what happens with the climate in years ahead.

Stirrings within the Federal Government

The federal government has most effectively put the spotlight on climate change adaptation through the May 2014 release of its Third National Climate Assessment, with self-described findings that "underscore the need for urgent action to combat the threats from climate change, protect American citizens and communities today, and build a healthy, sustainable future for our children and grandchildren." The report identifies many of the same concerns as those raised in three similar assessments produced in California since 2006.[64]

The Obama Administration has gradually raised the profile of climate change adaptation since taking office in 2009, starting with the establishment of an Interagency Climate Change Adaptation Task Force. In an October 2009 Executive Order, the Administration directed federal agencies to develop their first climate adaptation plans.[65] The adaptation plans, released in February 2013, have a special significance for California given the federal government's ownership of 44 million acres of

national parks, forests, wilderness, reserves and coastal areas in the state – nearly half of California's land mass.[66] In August 2013, testimony to the Commission, Ms. Moser, a climate adaptation researcher and consultant, stated, "In many instances, managing of these land and water resources does require interaction or coordination with other levels of government or private land owners in the state. Thus, if the federal government acts, it will engage and move others in the state."[67]

"The President's Climate Action Plan" released June 25, 2013, and a November 1, 2013, Executive Order – "Preparing the United States for the Impacts of Climate Change" – introduced strategies to factor climate change into federal infrastructure investments. Federal financial support for rebuilding after storm disasters will require designing to future conditions such as sea level rise, rather than to historic conditions. Agencies also will reconsider how they manage federal land and waterways and identify greater roles for natural systems such as dunes and wetlands to protect them from climate change. The order directed federal agencies to develop new climate preparedness tools to help state and local governments and the private sector make smarter decisions about climate change impacts. Agencies also were directed to address climate risks identified in their new adaptation plans.

California Leaders Appointed to Federal Climate Preparedness Task Force

The November 2013 presidential Executive Order also established a Task Force on Climate Preparedness and Resilience to advise the administration.[68] President Obama appointed Governor Jerry Brown among eight governors to the task force, and Los Angeles Mayor Eric Garcetti, Sacramento Mayor Kevin Johnson and Santa Barbara County Supervisor Salud Carbajal among its 26 members. (Mayor Johnson also chairs Resilient Communities for America, an association of 164 mayors and county leaders beginning to implement climate change solutions in the nation's cities and counties).[69] The task force, which met in Los Angeles on February 13, 2014, and in Washington D.C., on December 16, 2013, is expected to make recommendations in 2014 to the Interagency Council on Climate Preparedness and Resilience chaired by the White House and composed of 25 federal agencies.

During a February 14, 2014, visit to Fresno that spotlighted California's drought emergency, President Obama also announced a 2015 budget request for a $1 billion climate resilience fund. As proposed in the president's $3.8 trillion 2015 budget submitted to Congress on March 4, 2014, the money would help federal agencies such as the Interior Department, National Oceanic and Atmospheric Administration,

Environmental Protection Agency, Federal Emergency Management Administration and the Department of Homeland Security identify critical facilities in states and analyze their ability to remain functional after disasters. It also would support climate adaptation planning, improve coastal resilience to sea level rise and help states and communities strengthen building codes to improve protection against wildfires. The Obama proposal faces congressional scrutiny in the budget process leading to the beginning of a new fiscal year on October 1, 2014, as well as potential opposition in the Republican-controlled House of Representatives.[70]

President Obama, however, used his June 14, 2014, commencement address at the University of California, Irvine, to announce a second $1 billion fund to help, in the president's words, "communities to prepare for the impacts of climate change and build more resilient infrastructure across the country."[71] Through the new National Disaster Resilience Competition, state and local governments that experienced a presidentially-declared major disaster in 2011, 2012 and 2013 will compete for funding to rebuild in ways that protect against future disasters. (California experienced three such presidentially declared disasters: the 2013 Rim Fire in Yosemite, the coastal tsunami in 2011 and winter storms with flooding, debris and mud flows in 2011). The $1 billion requires no congressional approval and comes from existing federal recovery funds. Their source is the U.S. Department of Housing and Urban Development's (HUD) Community Development Block Grant-Disaster Recovery funding from the Disaster Relief Appropriations Act of 2013.[72]

An Historic Challenge for Governing

The potential magnitude of climate impacts on California's quality of life and powerful Pacific Rim economy has begun to lodge in popular opinion. A May 2, 2013, online poll of 875 registered voters in California by the California Business Roundtable and the Pepperdine University School of Public Policy found that 71 percent of California voters across the political spectrum view climate change impacts as a serious or moderate threat.[73] A subsequent May 2014 survey of 1,702 adults by the Public Policy Institution of California found that 61 percent of Californians say "global warming will pose a serious threat to them or their way of life in their lifetime." That is up from 45 percent in 2003. According to the survey, "72 percent of Democrats (and 56 percent of independents) say global warming will pose a serious threat while 68 percent of Republicans say it will not." Among Latinos, 81 percent stated that global warming will pose a serious threat.[74]

Nonetheless, only a tiny universe of Californians is focused on the practical issues of strategic response, advance planning and investment in climate adaptation. The state owes much to the innovators within state, regional and local government trying to define and prepare for what lies ahead. Yet it is not enough for forerunners in state government to plan and talk among themselves, lacking a broader range of input from the public, local governments and the private sector. While a 2012 state government assessment cited a "remarkable increase in awareness, concern, and understanding about climate change impacts and the need to adapt," it also reminded its readers that this work, however significant so far, still quietly remains in "the very early stages."[75]

Outside state government, entities such as the San Diego Foundation, San Francisco International Airport, the Silicon Valley Leadership Group and consulting giant AECOM are already moving ahead of the pack in assessing risks and preparing for climate impacts. California research universities lead much of the world in advancing climate science and understanding of its impacts. A range of statewide industries – Pacific shipping, insurance and risk modeling, construction and power generation – are envisioning responses to the climate challenge. So, too, are a growing number of regional and local governments, building alliances with nonprofit and private interests as in the Bay Area or pioneering in public sector risk assessment. The State of California must keep up.

State government reflects California's innovative spirit daily as it leads global efforts to reduce greenhouse gas emissions. Californians will benefit immensely if it applies the same pace-setting energy to climate adaptation. This is particularly true in building effective governance structures to address a phenomenon on the scale of climate change. The climate challenge is likely to severely stretch the institutional capacity of government at a time when minimizing disorder and maintaining stability will be imperative as perhaps never before. Maximizing state government organization and building risk assessment capacity at all levels of government in the face of the climate threat represents one of the great 21st Century challenges for the Governor and Legislature.

Governing for Climate Change

State government institutions will have a profound impact on whether climate change is handled smoothly or becomes a chaotic experience that pulls down California's standard of living and economy. The Commission's adaptation study reviewed institutional frameworks beginning to address climate change in California and elsewhere and generally found that no powerful, centralized administrative structure yet exists to navigate this challenge.

Within a state government system responsible for protecting a large population, economy and environment, there is no one agency, department, council or commission to conduct or fund climate risk assessment, map climate hazard zones, provide standard definitions of expected impacts for planning purposes or coordinate the adaptation funding that will become increasingly necessary. Many inside state government dispute the need for an additional governing structure to oversee climate adaptation and have made that clear to the Commission. Among them, Charles Lester, executive director of the California Coastal Commission, testified at the August 22, 2013, hearing: "I don't believe that California needs new agencies or major institutional overhauls to address climate change, as opposed to targeted improvements and improved coordination in the existing governing system. There are many state agencies and programs involved in climate change issues already and effort is being made to coordinate these existing state programs and authorities."[76]

"Institutions – in the broadest sense of the term – determine modern historical outcomes, more than natural forces such as the weather, geography, or even the incidence of disease."

Niall Ferguson, author. "The Great Degeneration, How Institutions Decay and Economies Die." 2013.

Yet a top concern that triggered the Commission's climate adaptation study remains: While California casts a large, powerful presence in the world for its pioneering efforts to reduce carbon emissions it has no equivalent-scale effort or structure to manage the inevitable impacts of climate change.

Since passage of the Global Warming Solutions Act of 2006 (AB 32), California has committed significant financial and government resources to stimulate a small reduction in global carbon emissions and most importantly, provide a road map for other states and nations to make similar accumulative reductions. [77] The California Air Resources Board (CARB) which is responsible for implementing AB 32, has rapidly pioneered a wide range of unique and aggressive carbon-reduction efforts, including the cap-and-trade program launched in 2012. The

State of California's efforts to reduce its share of global emissions enjoys a large and powerful political constituency that guards and enhances the state's direction within the Capitol. Overall, the concentrated, highly focused authority of the governing structure implementing AB 32 holds immense power over the state's largest economic sectors as it seeks to decarbonize them.

In contrast, the state's administrative efforts to defend the state from impacts of climate change remain advisory at best. Adaptation oversight is diffused throughout state government via a multi-agency Climate Action Team and the state's official adaptation strategy coordinated by the Natural Resources Agency, rather than concentrated in a single powerful body. While notable for the scale of their research and identification of strategies, the state's adaptation initiatives hardly compare with CARB's efforts to reduce carbon emissions. This can be viewed as a profound policy disconnect. The state's ability to adapt also will have a major impact on 38 million Californians and their $2 trillion annual economy.

In 2014, California Natural Resources Agency Secretary John Laird has acknowledged as much in public forums. Secretary Laird, testifying before the Assembly Select Committee on Sea Level Rise and the California Economy on January 16, 2014, said, "People are getting that emissions need to be changed, and we have to do it, and California is in the lead, whether it's AB 32 or cap and trade and many things. We are not at the same place on the adaptation side." On January 22, 2014, introducing the agency's draft "Safeguarding California" climate adaptation strategy, the secretary again cited a "tremendous amount of work" done to reduce greenhouse gases, but added, "I think the general public, government and people in public policy have been slower to move on what is called adaptation."

Daniel Mazmanian, professor at USC's Sol Price School of Public Policy, describes California's approach as a paradox: acting globally for the benefit of the planet by "enacting a comprehensive mitigation policy to reduce the emissions of greenhouse gases," but failing to act locally "through the adoption of an equally comprehensive adaptation policy for the state to protect its own public and private assets and interests."

Professor Mazmanian, a recognized authority on climate change governance issues and project director of the 2010 Pacific Council on International Policy study, "Preparing for the Effects of Climate Change – a Strategy for California," told the Commission on August 22, 2013: "What is disheartening, in view of California's reputation as an environmental policy leader, is the reluctance of the state's policymakers

to address as boldly the ramifications of a changing climate that will be visited upon the people of California."

Policymakers Lack Common Adaptation Standards

Two giant infrastructure projects in San Francisco Bay showcase California's lack of a centralized governing framework and common risk assessment standards to guide climate change adaptation, USC's Mr. Mazmanian told the Commission. One is the California Department of Transportation's $6.4 billion Bay Bridge replacement span, opened September 2, 2013. The other is Treasure Island, a residential, commercial and office development project overseen by the City and County of San Francisco's Treasure Island Development Authority. Mr. Mazmanian told the Commission, "The Oakland terminus of the new Bay Bridge may go underwater. Next door, Treasure Island was developed with 55 inches of sea level rise in mind."

Such inconsistency, multiplied countless times across the state, reveals potential for disarray if different layers of government continue to make land use and infrastructure decisions in the absence of a larger governing framework for climate change adaptation. The randomness of this decision-making in a climate-changed environment could trigger litigation by project proponents and opponents over accuracy of project-by-project climate impact projections and make an already difficult and time-consuming development environment tougher, Mr. Mazmanian said. The USC professor described potential for eventual paralysis as decision-makers, contending with dueling and uncertain climate data in a contentious legal environment, increasingly fear the legal liability of making development and infrastructure decisions in a still-growing California. "Are we willing to let the absence of certainty about the future stop everything?" he asked.

Institutional paralysis and uncertainty represent serious climate risks in themselves as California governments begin to grapple with new notions of unstable and unpredictable geography – a diminishing Sierra snowpack, new precipitation patterns, consistently escalating temperatures and an ocean rising along 1,100 miles of coastline. John Englander, author of a 2012 book on global sea level rise, "High Tide on Main Street," told the Commission that the last time oceans began rising – about 18,000 years ago – the world's shorelines were largely uninhabited and required little action on the behalf of governing authorities. Those shoreline structures that did exist were handily moved inland, in contrast to the mass of today's oceanfront freeways, beach houses and neighborhoods.

Perceptual Roadblocks Impede Adaptation

The Commission learned during its study process that government agencies, just as human beings, are naturally confounded by a climate change phenomenon still largely existing in the future, highly uncertain at best and utterly lacking a helpful history of previous responses. It is useful then, before beginning to propose a new governing structure for climate change adaptation, to explore briefly the perceptual roadblocks and everyday obstructions that form institutional barriers. The Commission believes that these are critical to understanding the climate change governing challenge. In an academic paper reviewed by the Commission, Mr. Mazmanian describes three particular perceptual blocks that hamper public agencies as they begin to confront climate change adaptation.[78]

The Death of "Stationarity"

Stationarity is a term describing the fixed, predictable geography that people take for granted because it has existed as long as they can remember. The idea holds that future geography such as the course of a river or the coastline of an ocean can be reliably projected by looking at conditions of the past. Stationarity has guided several thousand years of reliable investment and business decisions and remains the basis for locating permanent infrastructure, buildings and millions of Californians from San Diego to the Oregon border. Stationarity, however, as an instinctive human perception about tomorrow, will be irrelevant and unreliable in a climate-changed California. "Erecting a Gothic cathedral along the shoreline and expecting it to endure 1,000 years would not be prudent," stated Will Travis, former executive director of the BCDC, in written testimony for the Commission's October 24, 2013 hearing. He and other witnesses told the Commission that in tomorrow's California, city council members, state agencies and local planning departments will encounter entirely new and perplexing questions:

- What is the smart vote on a proposed seaside hotel that may have to be removed in 25 years due to sea level rise, possibly at taxpayer expense?
- What size highway culverts are needed for a 2050 climate?

What to Do When Historical Data Becomes Irrelevant?

"Climate change undermines the reliability of historical data. When assessing the future risk of a hurricane or drought we are used to looking backward over time for patterns that we can then project forward into the future. With a long enough record and precise enough information, reasoning goes, our ability to assess risk increases. But with climate change all bets are off. The one thing we know is that the future will not be like the past."

Source: Robert Verchick, Gauthier-St. Martin Chair in Environmental Law, and Abby Hall, Policy Analyst, U.S. Environmental Protection Agency. 2011. "Adapting to Climate Change while Planning for Disaster: Footholds, Rope Lines and the Iowa Floods."

- How should a waterfront community react when a neighboring city proposes a new seawall that will push storm surges onto its shores instead?
- Should the California Environmental Quality Act be amended to require planners to consider the impact of a changing environment on a development project – rather than the current law requiring the impact of the project on the environment?
- Is it reasonable to build a multi-billion-dollar tidal barrier across the Golden Gate to defend an expensive Bay Area shoreline ringed by economically important tech companies?

The "Dictatorship of the Present"

Preparing appropriately for climate change impacts will require investing today's tax dollars or passing general obligation bonds to benefit the lives of those to come. Yet, in the wake of the Great Recession, city, county and state budgets throughout California are already stretched to meet current needs and pay down debt. In the corridors of the Legislature, few are lobbying policymakers to finance the climate adaptation needs of 2050. Mr. Mazmanian cited the political difficulties of thinking and investing forward as a prime barrier to responding effectively in a democracy to needs of the future. While true under any conditions, this difficulty is likely to loom heavily over climate adaptation efforts.

In "A Great Aridness," a 2013 book about climate change and prospects for long-term drought in California and the American Southwest, author William deBuys also attests to the conceptual difficulty of taxpayers and their governments sacrificing for future generations: "If one were to write a survey of all the instances in the history of civilization when societies accepted difficult medicine in order to spare their descendants worse pain in the future it would make a very short book."

Added sea level rise expert Mr. Englander in his book, "High Tide on Main Street," "Our grandchildren will not look back kindly on our era if we do not quickly begin to expand the scope of our response beyond what is politically and financially expedient."

Lack of Clear, Quantifiable Adaptation Goals

An especially difficult perceptual barrier for climate change adaptation is its lack of precise, targeted and authoritative goals compared to those for

curbing or mitigating carbon emissions. The Intergovernmental Panel on Climate Change (IPCC), a global scientific authority on emissions reduction, for instance, aims to limit increases in global warming to no more than two degrees Celsius by 2050."[79] The California Air Resources Board, too, employs a specific and targeted approach: reducing California's greenhouse gas emissions to 1990 levels by 2020. Targets are easy to understand, rooted in successful 1970s and 1980s campaigns to clean the air, reduce smog and use of aerosol sprays that threatened the earth's ozone layer. Adaptation to climate change lacks handily-defined targets advocated by international scientists, policy bodies and corps of activists. No one has proposed reducing California acreage burned by wildfires to 1990 levels by 2020. There is no global target to make coastal development withstand six feet of sea level rise by 2100. Carbon emission reduction has one identifiable goal. Adaptation has many, presenting a challenge for government to prioritize effectively within new or existing governing structures.

Everyday Institutional Barriers to Adaptation

"For all the drama it is capable of creating, climate change is ultimately about a million boring little fixes... These boring little fixes can have a profound impact."

Heidi Cullen, author. "The Weather of the Future." Harper, 2010, New York City.

Beyond such large perceptual barriers, the Commission learned, are the routine institutional varieties that checkmate new ideas and hinder progress. The federal government, for instance, has only recently begun to make climate adaptation a top priority, which has left states for years without guidance and financial support. States often lack experienced leadership in adaptation at the highest political levels, and lack public pressure to make climate adaptation a higher priority. State agencies typically rely on irrelevant historic information and assumptions of stationarity out of habit or legal mandates. Local governments have these problems and even fewer information sources, funds and structures to support adaptation planning. A growing body of research on institutional barriers indicates that local governments trying to prepare for climate change also are stymied by jurisdictional conflicts with neighbors and regulatory roadblocks with other layers of government.[80]

Witnesses told the Commission that government institutions are most hampered by the very purpose of their existence, which is to be agents of stability. In August 22, 2013, testimony to the Commission, Ms. Moser, a leading expert in institutional barriers and governance issues related to climate change, stated:

> *"It should not come as a surprise that institutional barriers are among the top types of hurdles. The purpose and nature of institutions is to stabilize, routinize and harmonize situations, and/or to standardize procedures. Institutions – understood not as organizations but as the informal and*

> *formal rules, norms, clusters of rights, and decision-making procedures – work best when circumstances do not change, and they can make processes clumsy, more costly and inefficient when circumstances change. The greater the contextual change, the more limited become decision-makers' options and action space to accommodate it if institutions remain unchanged. In other words, static institutions and progressive climate change are on a collision course."*

An Example: San Francisco International Airport

Testimony from a representative of San Francisco International Airport (SFO), owned and managed by the City and County of San Francisco, provided the Commission a vivid example of routine institutional barriers that hamper climate adaptation in California. Joe Birrer, principal engineer for design, construction and technology at SFO, testified at the February 27, 2014, hearing that the airport's sea level rise preparations must clear nine permitting agencies, all with "overlapping policies and regulations." Permitting agencies include the San Francisco Bay Development and Conservation Commission, U.S. Army Corps of Engineers, San Francisco Bay Regional Water Quality Control Board, Federal Aviation Administration, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, National Marine Fisheries Service, Bay Area Air Quality Management District and Federal Emergency Management Administration.

Mr. Birrer testified, "There is no consistent approach or guidelines on the local, state or federal level specifically addressing sea level rise. Permittees such as SFO are often left to address each agency policy and criteria without consistent guidance between the local, state and federal agencies."

An especially frustrating institutional barrier confounding SFO is its inability to get neighboring properties – governed by other public jurisdictions – to align flood prevention efforts with those of an airport that directly accounted for $5.4 billion in California economic activity and 33,580 jobs in 2012.[81] Mr. Birrer told the Commission that SFO can do everything possible on its property to keep runways dry and conceivably still suffer flooding from neighboring jurisdictions' properties to the north and south. "There must be cooperation between regional and sub-regional entities and a cohesive plan which spans jurisdictional boundaries to protect everyone against sea level rise," he testified.

New Governing Structures to Overcome Barriers

The Commission spent considerable time during its study process considering how state government might help California overcome institutional barriers and put thousands of local, regional and state governing agencies on the same page regarding climate adaptation. Many who advised the Commission acknowledged there is no game plan to confront the endless differing predictions, varying interpretations of climate data and disagreements over such basic questions as whether sea levels might rise three feet or five feet by a given year in the future.

The imprecision of climate change is difficult for busy government officials, as revealed by San Francisco Bay Area government representatives who responded to a 2013 survey conducted by the region's Joint Policy Committee. Respondents said they have no time to be climate scientists, nor to dig through competing climate change scenarios and determine the most accurate forecasts for their communities. Commission witnesses described a realm of California climate change planning in which "mostly, people are doing things separately. Everyone is reinventing the wheel on their own, essentially."[82] The Commission believes that maintaining this status quo will largely provide opportunity for uninformed decisions that lead away from comprehensive solutions toward piecemeal fixes likely to waste public funds and make conditions worse.

Yet the Commission faced a daunting challenge when considering whether to recommend a single governing structure for climate change adaptation. There are few models from which to learn. The best available working model, perhaps, is the New York City Mayor's Office of Long-Term Planning and Sustainability (OLTPS). Another is the Climate Risk Council proposed in 2010 by an expert California Adaptation Advisory Panel to the State of California convened by Governor Schwarzenegger. The Climate Risk Council proposal was not implemented, failing to gain traction within the Brown Administration and the Legislature. A brief explanation of both structures follows.

Showing a Way Forward: New York City

No government in the United States has likely done more to advance a powerful structure to govern climate change adaptation than New York City in the wake of its 2012 encounter with Hurricane Sandy. In June 11, 2013, former New York City Mayor Michael Bloomberg announced a detailed $20 billion climate change defense plan for the nation's largest city, a series of concrete actions and planning tasks spelled out in 438 pages of "A Stronger, More Resilient New York."

Actions called for fortifying the city's power grid, upgrading buildings to withstand hurricanes and "building an extensive network of flood walls, levees and bulkheads along its 520 miles of coast."[83]

But the Bloomberg Administration most clearly pushed the frontiers of climate change governance by appointing a single entity to oversee and implement the city's climate defense plan. "An initiative without a clear owner is destined to fail," the administration report noted. The job has fallen to the Mayor's Office of Long-Term Planning and Sustainability (OLTPS). The office, created in 2006, is deeply experienced with interagency coordination, well educated about climate change and its impacts on New York City and long practiced in developing and implementing long-term efforts.

"An initiative without a clear owner is destined to fail."

City of New York. June 11, 2013. "A Stronger, More Resilient New York." PlaNYC.

Within the OLTPS, a new director of resiliency coordinates activities among three interagency working groups responsible for three specific areas of climate adaptation: protecting the coast, implementing recommendations for climate-safe buildings and steering long-term storm recovery and resiliency efforts. A guiding strategy of "clear accountability" assigns individual initiatives such as transportation, wastewater treatment, telecommunications and parks to a single designated agency or office that owns them and is, in turn, overseen by the interagency groups. The OLTPS will update its long-term resiliency plan every four years beginning with the first in 2017. Regular updating will help the city monitor progress, build transparency and advocate for necessary changes, said Leah Cohen, a Californian and senior policy advisor for climate resilience within OLTPS. Ms. Cohen told the Commission the federal government is the city's largest partner, funding $15 billion of the $20 billion governing and infrastructure plan.

Implementation falls now to New York City's new mayor, Bill de Blasio, elected November 5, 2013. De Blasio signaled in January 2014 that he will continue the momentum, launching a competition to help small businesses impacted by Hurricane Sandy prepare for future storms, sea level rise and other effects of climate change. The competition was a key recommendation of "A Stronger, More Resilient New York."[84]

An Earlier Proposal: The California Climate Risk Council

New York City's OLTPS governing strategy shares similarities with the Climate Risk Council idea proposed in California in 2010. The expert advisory group, chaired by Mr. Mazmanian, envisioned a single "credible, authoritative and scientific professional entity to assess climate risks to the built and natural environments throughout California." As proposed, the council's definitive assessments of climate risk would help planners, developers and decision-makers avoid negative consequences,

particularly when making land use decisions. Reliable information provided by the council would be the key to building capacity for climate adaptation decision-making at regional and local levels, including the production of risk maps. The net effect of the proposed council, according to the report, would "meet the goal of infusing climate science and adaptation strategies into planning throughout the state." As described by the 2010 advisory panel:

> *"The Council would be a relatively small State entity (with no more than five board members, with a designated chair), appointed by and reporting directly to the Governor. To serve as knowledgeable overseers of CRC activities, Council appointees will need to have experience with and an appreciation of climate change science, risk assessment, and economics. In addition to having the requisite technical proficiency, the Council will need to represent a breadth of stakeholders from the private and public sector interests in the state … The Council will need a professional staff and adequate funding. In particular, it will require an experienced and insightful executive director and a staff skilled in risk assessment, risk characterization process, cost-effectiveness and other relevant long-range analytical techniques. They must be prepared to convey how this information can be applied to large-scale development and infrastructure projects at the local, regional and state level. In launching the CRC, the professional staff should be drawn from the extent possible from within state agencies, and departments (e.g., the Energy Commission, the Resources Agency, the Coastal Conservancy and CalEPA)."*[85]

Key council tasks proposed by the advisory group:

- Compile, organize and assess scientific information on accelerating climate change effects at the state and regional levels.
- Develop, periodically revise and update risk assessment protocols and guidelines.
- Advise public entities responsible for carrying out long-term projects on how to incorporate risk assessment, risk characterization and options assessments within their planning procedures and practices.

The 2010 advisory panel also proposed that development project applicants use Climate Risk Council assessments rather than conduct separate studies to satisfy new California Environmental Quality Act

(CEQA) obligations regarding climate risk analysis. The new obligations stemmed from a 2010 change to the CEQA Guidelines, Section 15126.2(a). The change required that environmental impact reports include analysis of possible negative impacts of new development in areas endangered by climate-driven risks such as wildfire, flooding and sea level rise. Defenders of CEQA objected, however, to developers using Climate Risk Council assessments to meet CEQA-required climate analysis.

A New State Entity to Guide California?

Traditionally, the Commission rarely proposes state agencies or governing structures in the belief that government can accommodate new problems with existing structures. But climate change promises to be extraordinary, a permanent and transformative condition requiring more flexible and nimble governing approaches. Above all, climate change will require the best possible information and guidance with which to prepare, act and adapt.

A key question guided the Commission's review of climate change adaptation: What will help California's decision-makers produce comprehensive responses rather than a confusion of individual solutions that may waste funds and make conditions worse? The Commission learned during its study process that local governments especially have made progress on the ground and are, in many cases, setting the pace nationally. Therefore, a first order of business for the Commission is to recognize what is working – what processes by which local governments are a model for success – even as it proposes new approaches.

Broadening the Vision of Climate Governance

"Govern*ance* is broader than govern*ment*. It widens the scope of investigation beyond the state and the mechanisms for decision-making codified in the law, acknowledging that civil society and non-state actors play in making decisions and setting priorities. Planning for sea level rise and storm events is not only the domain of regulators and politicians. It also involves private landowners, businesses near the coastline, nonprofit and community organizations and others."

Source: "Adapting Governance For Rising Tides." May 2013. Bay Conservation and Development Commission. National Oceanic and Atmospheric Administration. http://www.adaptingtorisingtides.org/wp-content/uploads/2013/06/Governance-Issue-Paper_FinalMay2013_Full.pdf.

A second significant question also guided the Commission's inquiry: Is organizational change necessary to make statewide adaptation to climate change more efficient? The Commission believes the answer is "Yes." The status quo, consisting of state government efforts to date, is moving slowly, is understaffed and inwardly-centered on state agencies and largely focused on broad vulnerability as opposed to location-specific

risk. It also lacks adequate scientific expertise and command of the best-available risk assessment methodologies.

The Commission heard a variety of ideas and suggestions supportive of organizational change. The Nature Conservancy's California Climate Change Program proposed a California Climate Commission "to oversee the many and sometimes disparate efforts" of state government. The Nature Conservancy's proposed commission would consist of representatives from state and local government, the public, scientists, urban activists and environmental groups. "It would absorb the existing Climate Action Team and establish mechanisms for public participation and accountability," stated a letter to the Commission from Louis Blumberg, director of the conservancy's California Climate Change Program.

Kate Meis, executive director of the Sacramento-based Local Government Commission, similarly proposed a "Local Adaptation Commission" within state government. In testimony to the Commission, Ms. Meis stated, "The Governor could appoint leading local elected officials to the Commission tasked with developing a menu of adaptation policies. Cap-and-trade and other state funding could be tied to achieving a level of points through selecting locally relevant and feasible policies from the menu." An additional alternative suggested by Ms. Meis included an official adaptation council within the Governor's Office of Planning and Research or the Strategic Growth Council to serve as "the forum for state and regional discussions."[86]

Witness testimony at three public hearings and an advisory committee meeting on risk assessment helped the Commission reach a pair of pivotal conclusions about how California can meet its climate challenge more effectively. Both could be considered significant starting points to begin a long, unconventional journey of governing California, provide vital new information for decision-makers and fund implementation of their decisions. Each also preserves the right of the Governor and Legislature to make climate adaptation policy, and for the Governor to direct statewide adaptation efforts, either within an existing state entity with the resources and capacity for the mission or within a new administrative structure.

- California should create within its state government a new entity or enhance the capacity of an existing state organization to establish the best-available state science and risk assessment procedures for anticipated climate impacts.
- California also should employ the Strategic Growth Council's planning and grant-making process to build stronger climate adaptation efforts in cities, counties and regions statewide.

A One-Stop Source for Planning, Action and Education

The Governor and Legislature can choose from a menu of options to establish the state's authoritative source of science regarding climate risks. Whatever the choice, it will provide California governments their first one-stop source of standardized information to begin responding to climate risks. A structure within a new or existing entity, backed by a science board, would go far toward informing decision-makers and helping answer the question much on the minds of government officials: "We know about climate change. But what should we be doing?"

"We have plenty of research about impacts, science and strategies, but not much at all about how to plan and make decisions," said Bruce Riordan, a climate change consultant and strategist with the Bay Area's Joint Policy Committee. "It's kind of an evolutionary process. Everybody is struggling with this," he said in a 2013 conversation with the Commission. Mr. Mazmanian also told the Commission, "There are a lot of vulnerability studies and all sorts of studies on vulnerabilities and modeling. But there is very little admonition on what we should do. No one knows how to deal with it beyond individual response. There are no guidelines at any level other than individual response."

By existing solely as a definitive source of risk information and not as a climate policymaking body, a new or enhanced existing organization could help government officials choose from competing climate impact scenarios. It could spur more uniform responses by local governments now developing different responses to climate change – even when they are located next door to one another. Each city has varying perceptions and tolerances of climate risks and there is no uniform way of planning and developing risk assessments. As envisioned by the Commission, such an organization would assess emerging climate science

Key Concepts of Vulnerability and Risk

In the Adapting to Rising Tides project, the San Francisco Bay Conservation and Development Commission defines the key concepts of vulnerability and risk as:

Vulnerability: The degree to which an asset is susceptible to or unable to accommodate the adverse impacts of climate change. There are three primary components considered in vulnerability assessments: exposure, sensitivity and adaptive capacity.

- **Exposure:** The extent to which an asset experiences a climate impact.
- **Sensitivity:** The degree to which an asset would be impaired by a climate impact.
- **Adaptive Capacity:** The ability of an asset to make accommodations or adjustments to a climate impact and maintain its primary functions.

Risk: The likelihood of a climate impact occurring and the magnitude of potential consequences from the impact.

- **Likelihood:** The chance or probability of a climate impact occurring.
- **Consequence:** The magnitude of social, economic, legal and environmental effects if a climate impact occurs.

Source: San Francisco Bay Conservation and Development Commission. Adapting to Rising Tides. "Introduction to the ART Vulnerability and Risk Assessment." September 2012. Vulnerability and Risk Assessment Report. http://www.adaptingtorisingtides.org/wp-content/uploads/2012/09/CH-1-Intro.pdf.

and develop and oversee a process of determining the anticipated risks. Most importantly, it would help public entities begin to incorporate standardized California risk analysis of climate impacts – for existing development and future growth – into their climate adaptation planning. This will begin to move California beyond simply gathering information about its broad vulnerability to a more sophisticated understanding of location-specific risks and consequences. The best-available analysis will create a foundation for governing agencies to rigorously evaluate their risks and begin to confidently invest in defenses, plan ahead and make the most appropriate land use and development decisions.

In Commission testimony on August 22, 2013, Stephen G. Bushnell, senior director of Novato-based Fireman's Fund Insurance Company, said that all the sophisticated risk modeling tools available to private insurers also are available to the government sector as it considers location of infrastructure and private development. "All the risk tools that are available to insurers are available to the state," he said.

Whether new or part of an existing entity, a structure envisioned by the Governor or Legislature also could assume a leading role in educating the public about the probable impacts of climate change. A key component of any large-scale education campaign by the entity must be the immense potential costs of inaction and failing to prepare. Building a public constituency to support the action and spending necessary to prepare California requires that people understand the threat is real and that solutions are possible. R. Zachary Wasserman, chair of the BCDC, told the Commission during its October 24, 2013, hearing: "One of the tasks we are all about is scaring ourselves with the reality, and at the same time giving ourselves hope that there will be solutions. Because if we don't do both, there will be no movement." In additional written testimony for the hearing, Mr. Wasserman said a public education campaign "should offer residents non-threatening information about what might occur, how different levels of government are planning for its ramifications and how communities can discuss policy options."

The 2010 Pacific Council on International Policy report, "Preparing for the Effects of Climate Change – a Strategy for California," by the California Adaptation Advisory Panel to the State of California, similarly cited the need to educate, but not scare Californians about threats and options, particularly regarding sea level rise. "Much like other populations in the state, coastal residents are not well informed and equipped to engage constructively in adaptation decisions," the report started. "We recommend that the state and other funders support research and then develop, test, adjust and launch a scientifically informed outreach campaign to coastal residents and businesses about climate change impacts on the coast and adaptation options." The

advisory panel also called for more widespread education and training of planners, agency managers, consultants and decision-makers.[87]

Administering a Newly-Created Entity

If the Governor or Legislature decided to create a new organization – a council, commission or board – it would not have to look far to find a model. Similar structures already exist within state government. Many function independently of the Governor's Office with an executive director and board of part-time appointed members with technical expertise and representative of private and state and local public sector interests in the state. An entity designed in this case, as a definitive source of climate impact science, would benefit from an independent science board like those that assist the Delta Stewardship Council and Ocean Protection Council. As climate science is an ever-evolving area of study the science board should be responsible for keeping information updated and maintained. A science board could assess and help set agreed-upon statewide and regional standards of anticipated impacts and risks. A science board also would create a scientific, rather than a political foundation, to help the state specify climate risks and understand the newest-available information. Specific, agreed-upon standards would go far to build trust and help California's governments design and plan for the future based on the best available knowledge.

Among existing models to consider when reviewing options:

- ***The Delta Stewardship Council***, created by the Legislature in 2009 to oversee protection of the Sacramento-San Joaquin River Delta and provide Californians a reliable water supply. This small institution may be the best model, given its mission to find solutions to the particularly thorny and multifaceted issues of the Delta. The council consists of seven members representing a mix of agricultural, urban and water interests. Four are appointed by the Governor and one each by the Senate and Assembly. The seventh is the chair of the Delta Protection Commission. The Legislature, according to the council, created it "to be small and authoritative as compared to the more than two dozen state and federal agencies that made up CALFED." (The CALFED Bay-Delta Program). The Legislature also made it an independent state agency, equipping it to achieve two co-equal goals for the sensitive Delta region: to provide a more reliable water source for California and protect, restore and enhance the Delta ecosystem. The council created a Delta Plan, which went into effect on September 1, 2013, and provides standards and a framework to accomplish the goals. A 10-member board of renowned scientists from throughout the nation advises the council and oversees the

"scientific research, monitoring and assessment programs that support adaptive management of the Delta through periodic reviews of those programs," according to the council. The council has approximately 55 employees, according to the enacted 2013-2014 state budget.

- ***The Strategic Growth Council***, created in 2008 to review infrastructure plans, align state infrastructure and other spending with statewide growth goals while limiting greenhouse gas emissions. The council exists within the Governor's Office and consists of seven Cabinet secretaries and one public member appointed by the Governor. The Cabinet-level members represent the Governor's Office of Planning and Research, California Environmental Protection Agency, Natural Resources Agency, Department of Food and Agriculture, Transportation Agency, Health and Human Services Agency and Business, Consumer Services and Housing Agency. The council uses four strategies to fulfill its mission – coordinating state programs, providing local assistance, funding and distributing data and information and recommending policies that advance sustainable communities. The council spends considerable time at the nexus of state and local government, interacting with local and regional governments and understanding local needs, a model for how a new structure might do the same. The council's executive staff consists of five employees.

- ***The California Ocean Protection Council***, created in 2004 to coordinate ocean-related activities of state agencies and steer grant money to ocean projects. The council consists of seven members who include the secretaries of the Natural Resources Agency and California Environmental Protection Agency, the state Controller, a representative each from the State Assembly and Senate and two public members appointed by the Governor. The council is tasked with coordinating activities of ocean-related state agencies, coordinating the collection and sharing of scientific data and identifying and recommending changes in state and federal law to the Governor and Legislature. A Science Advisory Team with 21 members based throughout California and coordinated by the California Ocean Science Trust provides guidance to the council. Likewise, a steering committee of 14 senior representatives of state departments, boards and commissions with responsibility for the ocean and coastline, also guides the council. The council has six staff members and two fellows. During 2013 and 2014 the council is funding approximately $2.5 million for coastal communities to improve their defenses and update Local Coastal Programs, the basic

planning tool to guide coastal development in cities and counties. The grants are funded by Proposition 84, the $5.4 billion Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006.[88]

- ***The California Transportation Commission***, created in 1978 to coordinate the state's transportation sector and provide unified statewide transportation policy. The commission was formed for much the same reason that prompts a recommended entity for climate change impacts: a scattering of transportation policy across numerous departments, agencies and boards. The independent commission has 11 voting members, nine appointed by the Governor and one each appointed by the Senate and Assembly. The chairs of the Senate and Assembly transportation committees are ex-officio non-voting members. The commission is best known for overseeing a comprehensive bottoms-up transportation funding process that incorporates local priorities into regional transportation plans which receive state funding. The commission has a staff of 18.

- ***The Office of Environmental Health Hazard Assessment (OEHHA)***, created in 1991 as the lead state agency for the assessment of health risks from environmental contaminants.[89] While OEHHA is a department within the California Environmental Protection Agency (CalEPA) and not a council-type structure, its primary function is science-based assessment of public health risks. The department defines its role as "developing and providing risk managers in state and local government agencies with toxicological and medical information relevant to decisions involving public health." Agency users of OEHHA's risk assessment information include CalEPA boards and departments, the departments of public health, food and agriculture, fish and wildlife, justice and the Governor's Office of Emergency Services. A key OEHHA contribution to helping elected officials and the public understand health risks at the census tract level is its CalEnviroScreen 2.0 mapping and data tool which clearly identifies communities most at risk and most vulnerable to impacts of pollution.[90] It is easy to envision a similar mapping tool to assess climate risks at the census tract level. The department also has applied its risk assessment methodologies to climate change, producing the 2013 report, "Indicators of Climate Change in California," which describes changes in the state's climate and its impacts on the environment and people.[91] Approximately two-thirds of the department's more than 100 staffers are scientists.

An Authoritative Guide for Assessing Local Risks

The Commission envisions its proposed climate-focused entity becoming the authoritative statewide source for local and regional governments to connect with the state regarding the daunting new processes of assessing their climate risks. The state government body would help drive a necessary paradigm shift in California from historic to predictive risk assessment. Trusted state-level experts can help communities understand the type of climate risks specific neighborhoods will encounter, enabling local officials to develop targets and responses that resolve real issues and avoid potentially costly and unnecessary actions.

The entity also might be an authoritative source of legal risk assessment tools to help local governments evaluate the legal risks of implementing various measures, as well as the legal liability of failing to take adaptation measures. That threat may be real. Los Angeles-based Farmers Insurance Co. briefly explored the potential for local government liability after many of its customers suffered property damage and losses during a torrential April 2014 downpour that Chicago officials labeled "a new kind of storm associated with climate change."[92] Farmers sued the City of Chicago and nearly 200 other area communities in May 2014, alleging that "local governments should have known that rising global temperatures would lead to heavier rains and did not do enough to fortify their sewers and stormwater drains." The lawsuit received considerable attention before Farmers suddenly dropped it the following month, declaring its hopes that the suit and resulting publicity would prompt cities and counties to further reduce their flood risks.[93] When initially filed, The Insurance Journal called the insurer's nine class actions "the first in what could be a wave of litigation over who should be liable for the possible costs of climate change." Experts, too, initially called the lawsuits "a long shot," but acknowledged an accumulation of such cases could build legal precedent for courts to act upon in the future.[94]

At the state level in California, agencies have made impressive gains in building vulnerability assessments that measure the potential danger of climate change impacts. But even state-level government is only beginning to conduct the more specific and detailed risk assessments that measure actual likelihood of a climate impact, potential consequences in immediate neighborhoods and the resulting economic disruptions farther away. Flooded freeways near the Port of Oakland, for instance, would not only disrupt regional traffic and prevent employees from getting to work, but also would prevent fresh agricultural shipments in the distant San Joaquin Valley from reaching overseas markets.

The Commission's risk assessment advisory committee, which convened February 26, 2014, cited a general lack of guidance and clarity from the

state for assessing climate risks. While the state has developed a climate change adaptation planning guide to support and guide local and regional communities, a committee participant told the Commission that the guide is "just scratching the surface." The statewide Cal-Adapt tool created by the California Energy Commission also is not a comprehensive resource in finding anticipated climate impacts in specific local areas. A panel participant said that "Cal-Adapt is a good step forward, but stopped way short of where to go. Trying to use quantitative data analysis from it is difficult."

The Commission learned that local and regional jurisdictions are challenged with critical questions of what climate scenarios and timeframes to which they should plan. City and regional officials are not sure if they should plan for low, moderate or extreme impacts, advisory panel participants said. One participant said cities lack state guidance on how far out into the future they should be planning and how to deal with uncertainty. Another said that cities need more clarity on the likelihood, probability and consequences of risks. The Commission heard that many jurisdictions simply do not know what specific climate risks for which to plan.

Not a Policymaking Body

As envisioned by the Commission, any state structure charged with providing the best science and risk assessment procedures to prepare for climate change impacts, would, as stated earlier, exist primarily to inform regulators and decision-makers regarding the questions and climate risks just described. It would continually update decision-makers with new science as it becomes available. The Commission does not see this proposed structure as a policymaking body. It would not dictate local land use decisions or jeopardize in any way California's time-honored principle of local control over land use. While some believe that climate change is a condition that calls for overriding local control, the Commission heard repeatedly in testimony and interviews of its vaunted importance to local governments.

Instead of exercising authority or judgment in individual land use cases, the organization would begin the comprehensive work of incorporating climate change adaptation into local, regional and statewide planning throughout California. Climate adaptation policy by relevant state and local agencies would be informed by the organization's risk assessment standards and agencies would plan consistent with these standards. Over the long run, the standards, updated as needed to reflect emerging climate conditions, would gradually, thoroughly embed themselves into state and local planning and development processes, helping California prepare adequately and respond well to what comes.

Making the Private Insurance Market Work More Effectively

Adequate advance planning and preparation has an added benefit of making the private insurance market work more effectively in California. The prospect of climate change has prompted new consideration nationally and inside California of the insurance sector as a key participant in reducing risk and minimizing government financial and disaster aid. The insurance industry has great experience in assessing and pricing risk, easing financial impacts of weather damage and helping communities rebuild. The industry's effectiveness, however, rests on the government sector's ability to keep the maximum number of people out of harm's way.

"Insurance cannot play its role if land use regulations, building codes and physical construction are not sufficiently robust," stated a 2009 analysis by the Heinz Center and Ceres of storm threats to coastal states, "Resilient Coasts: A Blueprint for Action."[95] The report highlighted government's responsibility to reduce climate risk exposure so private insurers can spread a wider net of protection. Insurers contend that while increased storm damage payouts in recent years is partly from more intense and frequent storms, it is mostly due to rising numbers of properties built in storm paths. Frank Nutter, president of the Reinsurance Association of America, told the U.S. Senate Environment and Public Works Committee on July 18, 2013, that local governments still issue an average of 1,355 building permits daily in vulnerable coastal counties that are home to 39 percent of the U.S. population.[96] In Commission testimony on August 22, 2013, Mr. Bushnell of Fireman's Fund said the insurance industry does not see a major role for itself as a lobbyist for better land use regulations or building codes in California. The industry, he told the Commission, will send its signals in the language of the marketplace. "We react to decisions that governments make. The signal we send is that we stop writing policies. If you see the industry pull back, that's a signal that the land use decisions aren't right. If there is questionable land use you will see us gradually move from those areas."

Mr. Bushnell said his company's biggest concern currently in California is the rising threat and incidence of wildfire. That threat is rooted in another anticipated aspect of climate change: drought and the spread of pests and tree disease in forests. Mr. Bushnell said that the private insurance industry will be little involved with impacts of sea-level rise in California, as flood insurance coverage is largely provided by the federal government through the Federal Emergency Management Agency's National Flood Insurance Program (NFIP). The NFIP provides approximately 256,000 flood coverage policies in California.[97]

The NFIP program created in 1968 showcases the difficulties of raising rates to reflect the true risk of providing coverage in flood-prone areas. The federal flood insurance program is $24 billion in debt, with much of the shortfall attributable to artificially low subsidized rates and repeat damage claims for homes and businesses in the riskiest flood zones. Efforts by Congress through the Biggert Waters Flood Insurance Reform Act of 2012 to shore up the NFIP by charging more realistic rates in those zones were undone in early 2014 by political opposition from ratepayers.

Some climate research suggests potential for greater regulatory tension between private insurers and states that oversee them as insurers seek more ability to price premiums in line with true risk. The absence of this ability has caused some insurers to leave hurricane-prone areas, such as Florida. A handful of states such as Florida, Texas and North Carolina have even begun to offer subsidized low-cost insurance policies similar to the NFIP with the similar unintended risks of rewarding risky behavior and putting taxpayers on the hook for losses.

Sean. B. Hecht, executive director of the UCLA Environmental Law Center at the UCLA School of Law and formerly a California Deputy Attorney General, has written: "Our states' insurance regulators generally concern themselves with making sure that insurance is widely available and affordable. But this concern may not promote efficient outcomes if widely available, low-cost insurance motivates people to build and rebuild homes in areas prone to serious fire risk, costing public resources to maintain and protect private property." Hecht added, "Changing the role of state insurance regulators to require, or at least allow, actuarially sound pricing of risks affected by climate change seems unlikely. Nonetheless, some researchers and advocates have suggested that such a change will be necessary to cope with a new era in which disasters are more common."[98]

Lessons from Earthquakes: Mapping Climate Risks

Climate risk assessment is expected to evolve in tandem with climate science as experts refine their findings and try to narrow the inherent uncertainty of climate change. The Commission expects that leading-edge risk modeling to guide jurisdictions through uncertainty would become a paramount strength of a new or enhanced state entity. The Commission, in its 2013-2014 study process, did not try to determine how it and a science board might gauge risks or how policy might evolve as a result. But in hearings and through its risk assessment advisory committee process, the Commission learned that some of the ways the state already assesses risks have parallels with anticipated climate change impacts. The Commission also reviewed interesting new

proposals for how to assess climate risks for new development, particularly in the realm of sea level rise.

The California Geological Survey (CGS) offers perhaps the most familiar lesson for climate adaptation with its risk assessment and mapping procedures for earthquakes and landslides. The CGS procedures received considerable publicity in late 2013 amid media reports that substantial Hollywood development had occurred on and near earthquake faults that had gone unmapped due to two decades of state budget constraints. The reports noted that Los Angeles city planners and elected officials responsible for the land use decisions had no state warnings about the fault locations to guide their yes or no votes. Governor Brown and the Legislature later added $1.49 million to the 2014-2015 state budget for more earthquake fault mapping.[99] Potential impacts of climate change will require similar risk maps and state warnings to guide local land-use decision-makers. Might a proposed seaside hotel be swamped by a rising ocean in 10 years or a tsunami at any given moment? Does a proposed outer-ring subdivision or a new street alignment back up against a hillside prone to landslides after heavy and sustained rains? Should some areas simply be off-limits to development amid climate uncertainty? These questions invite consideration of how the state currently assesses certain risks – and their usefulness for assessing a newer generation of climate risks.

At the Commission's February 26, 2014, advisory meeting on risk assessment, participants from CGS told the Commission the CGS issues "zone" maps of elevated risk areas designed to quickly tell property owners, consultants and government permit desk employees whether a proposed location raises a red flag that prevents development altogether or can go forward with more analysis. Local agencies can use the zone maps to require further investigation by applicants proposing development within those zones. The CGS maps inform land use planning by their inclusion in the safety elements of city and county general plans and local hazard mitigation plans. They also are available to local agencies through the California Governor's Office of Emergency Services' MyPlan Web map service.

The CGS representatives said when local agencies and applicants use these maps and associated information they conduct more consistent analysis and ultimately make more informed land use decisions. The CGS process provides one example of the powerful role to be played by the state in climate change risk assessment. By producing and updating local and regional climate risk maps, it can provide accurate and objective information to local governments, and help elected officials withstand pressures to steer development into harm's way.

A New Paradigm: Risk Frameworks for a Rising Ocean

The prospects of a rising Pacific Ocean present special difficulties to government land use planners and elected officials who vote on development projects. Given lack of certainty about sea levels 30 or 50 or 100 years into the future, decision-makers face challenges from developers who may dispute local speculation about the possible extent of sea level rise to deny projects. Local officials, fearing twin perils of litigation and an uncertain future may become overcautious when making land use decisions, rejecting needed waterfront development and infrastructure. A government structure dedicated to providing the best available science might in such instances provide more than information. As its expertise and ability to withstand legal challenges grows it would provide necessary political and legal cover to officials facing difficult or unpopular decisions.

Mr. Mazmanian of USC has written, "Currently there is no covering framework that addresses adaptation policy and assists project-level decision-makers to decide on whether and what type of activities to authorize in the face of climate change."[100] In Commission testimony, he proposed a decision-making framework involving a 30-year rolling window to prevent a gridlocked development process in a still-growing California. "You have to start somewhere," he told the Commission at its August 22, 2013, hearing. "People find it hard to grapple with 2099. It's easier to look at 30 years."

Under Mr. Mazmanian's proposal – an example of what a new or existing entity might consider and recommend for decision-makers – shoreline development and infrastructure projects with at least a 30-year lifespan would have to demonstrate they could accommodate the best-available projections of sea level rise within that time frame. Project applicants would assume the risk if conditions turned out to be worse, and would have the option of planning for a worse scenario. The approving agencies, conversely, could not be held legally or financially liable if the effects of climate change turned out to be more severe than expected during the life of the project. Government regulators and decision-makers, likewise, could not deny or hold up development projects simply because they disagree with the best-available projections.

Mr. Mazmanian suggested using intermediate sea level rise projections from the Intergovernmental Panel on Climate Change (IPCC) and downscaling them to the specific project location. With each release of new IPCC sea level rise projections – typically every six to seven years – the rolling 30-year window would be modified to reflect the newest projections. The same method could be used for other decisions related to the built environment, providing perspective for development projects

proposed in wildland-urban interface zones prone to fire dangers and inland areas at risk of flooding.

Two other participants in the Commission's study process disagreed with Mr. Mazmanian's rolling window, saying it is better to declare a simple threshold and stick to it. During the Commission's August 22, 2013, hearing, Ms. Moser said, "You will at some point get three feet of sea level rise, but you don't know when. It's more important to set the threshold we find acceptable rather than a set period of time. We just don't know the timing."

"Adapting to Rising Tides:" A Climate Risk Assessment Model for California

Climate change adaptation is a complex process, and often has to do with adjusting and restructuring systems and infrastructure in a city or region. In order to tackle climate change's multiple facets, it is critical to lay a strong framework for building adaptation strategies, plans and implementation. The San Francisco Bay Conservation and Development Commission's (BCDC) $1.6 million "Adapting to Rising Tides" (ART) assessment of specific high water risks on 26 miles of Alameda County shoreline stands out as a flagship program for other California jurisdictions and regions to emulate.

The pioneering sea level rise risk assessment project, begun in 2010 and jointly funded by federal, state and regional partners – the Federal Highway Administration, National Oceanic and Atmospheric Administration, BCDC, Caltrans and Metropolitan Transportation Commission – has identified risks to hundreds of sites and potential defense strategies. Sea level rise in the pilot area could adversely affect up to 123,000 residents and individual properties with a current assessed value of $19.6 billion, according to agency analysis. The assessment evaluated ground transportation, community land use, parks and recreation, contaminated lands, structural and non-structural shorelines, Oakland International Airport, the Port of Oakland, hazardous waste sites and stormwater and wastewater systems. It also examined sea level rise and storm event exposure, sensitivity, adaptive capacity and consequences for each category.

The ART project identifies five major impacts associated with changes in storm events and sea level rise. Potential risks include more frequent and longer flooding events, frequent or permanent inundation of critical infrastructure, increased shoreline erosion, and groundwater intrusion and salinity. All have potential to disrupt key services such as transportation, fresh water supply, energy and health care throughout the entire region. The BCDC calls the ART project a successful model for identifying risks and strategies, as well as developing processes to integrate adaptation into local and regional planning and decision-making. Larry Goldzband, executive director of BCDC, said during a December 2013 sea level rise conference in San Mateo County, "We're doing this (project) collaboratively in a non-regulatory way so that folks in neighborhoods actually understand what will end up happening in their neighborhoods and can actually plan for it. ART is successful because it is non-threatening. It is non-regulatory."

Importantly, ART also provides one of the state's pioneering examinations of governance options to manage uncertainty. It discusses how adaptation might be incorporated into existing practices and work across urban and county boundaries through joint powers authorities, special districts and regional authorities

Source: "Adapting to Rising Tides." 2010. The San Francisco Bay Conservation and Development Commission and the National Oceanic and Atmospheric Administration Coastal Services Center. http://www.adaptingtorisingtides.org.

Mr. Englander suggested planning for three feet of sea level rise in all of California's coastal development. The author and consultant called it the easiest path to get started. "That changes the frame from 2060 or 2100," he told the Commission during a 2013 interview. "That sets the threshold for engineers and architects." R. Zachary Wasserman, chair of the San Francisco-based BCDC, made the same suggestion at a January 16, 2014, hearing before the Assembly Select Committee on Sea Level Rise and the California Economy. The BCDC, which reviews proposed development on the first 100 feet of Bay Area shoreline, currently requires developers to design projects that can withstand 16 inches of sea level rise by mid-century and up to 55 inches by 2100 if they expect their projects to remain in place that long.

Strategic Growth Council: Focus on Adaptation

State government's Strategic Growth Council, in combination with a proposed structure dedicated to providing science and risk information, offers a powerful two-dimensional opportunity to better inform and adequately fund climate adaptation efforts in California. While the council's role currently tilts strongly toward meeting the state's AB 32 greenhouse gas reduction goals, the Commission envisions a strategy that would build a stronger climate adaptation focus into the council's sustainable communities grant-making process.

The Strategic Growth Council, established in September 2008 with Governor Schwarzeneggger's signature of SB 732, is a cabinet-level body designed to align the state's varied General Fund and bond funding streams with its official growth and planning priorities emphasizing new development in existing communities. In its own language, the council is a coordinator of "activities that support sustainable communities, emphasizing strong economies, social equity and environmental stewardship" – key components, the Commission contends, of a climate-ready California. As described earlier, the eight-member council exists within the Governor's Office and consists of seven cabinet-level appointees – the Governor's Office of Planning and Research, California Environmental Protection Agency, Natural Resources Agency, Department of Food and Agriculture, Transportation Agency, Health and Human Services Agency, Business, Consumer Services and Housing Agency – and one public member.

Among the council's responsibilities is reviewing the state's five-year infrastructure plans which – when actually completed – often lack coordination and alignment with the state's broad growth policy goals. This infrastructure review process already offers the council a key point

to inject climate adaptation considerations into state agency decision-making.

The council's prime task is allocating Proposition 84 funds, acquired through the $5.4 billion Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006. The Strategic Growth Council has distributed more than $50 million in funding to regions through its Sustainable Communities Planning Grants and currently has $15.7 million remaining.[101] Most grants emphasize local and regional planning efforts required by the Sustainable Communities and Climate Protection Act of 2008 (SB 375) to reduce the transportation sector's 38 percent share of California's carbon emissions. A smaller, but increasing part of the funding also has begun to help regions do climate adaptation planning. New grant guidelines under SB 375 now require local and regional recipients to build adaptation considerations into their funding requests. Applicants are required to consider and apply "best practices for climate change vulnerability assessment, resilience planning and adaptation to the effects of climate change on the proposed project."[102] Applicants also are required to appropriately plan for sea level rise, in conjunction with the guidance provided by the Ocean Protection Council Resolution on Sea Level Rise.[103]

The Commission heard at its February 27, 2014, hearing that SB 375 planning strategies to encourage transit ridership, reduce vehicle use and steer more of California's job and population growth into existing cities could inadvertently expose more people to risks of sea level rise and other climate impacts. Jeffrey Goldman, principal at the consulting firm AECOM, testified that planners complying with SB 375 priorities aim to steer a substantial majority of new housing and jobs into urban neighborhoods and priority development areas, some vulnerable to climate threats. Such concerns suggest the council should develop a greater emphasis on climate adaptation that would add balance to the state's climate strategies. The council could easily stretch a definition of "sustainable communities" to include helping cities and regions prepare for and withstand climate change impacts.

In a 2013 interview with the Commission, Strategic Growth Council Executive Director Michael McCoy said the council's structure could handily house carbon emission reduction strategies and climate adaptation under the same roof. Regional officials have told the Commission that the Strategic Growth Council grant process would produce more effective local adaptation projects than those funded by state agencies. Kate Meis, executive director of the Local Government Commission, said the council's climate adaptation grants could help regions do "targeted small things that can be replicated. We need two or

three things to move the ball a little bit and build a menu of strategies for regions to try."

Notable among sustainable communities grants already awarded to cities and counties for climate adaptation activities are large recent allocations to Los Angeles County and Santa Clara County. In 2012, the council awarded $1 million to the Los Angeles County Metropolitan Transportation Authority and the Los Angeles Regional Collaborative for Climate Action and Sustainability to simultaneously advance climate adaptation and reduce greenhouse gas emissions. The funds represent a key driver of the region's multi-year climate plan: "A Greater LA: The Framework for Regional Climate Action and Sustainability." In 2012, the council provided Santa Clara County $991,000 to help the region identify climate risks and develop governing strategies to defend itself. The resulting "Silicon Valley 2.0" project is using a risk analysis and management framework to prepare the county's climate change adaptation plan.

Preparing Together at Nexus of State-Local Government

A gradual shift toward adaptation positions the Strategic Growth Council as a key partner of any climate adaptation entity envisioned by the Governor or Legislature. Operating at the critical nexus of state and local government, this entity could provide the best science-based risk assessment for government decision-making while the Strategic Growth Council's grants could fuel adaptation efforts at all levels throughout the state.

This synergy also fits into the Commission's preference for a regional dimension in addressing climate change adaptation. Local governments are challenged with limited financial resources to support their climate adaptation efforts. Culley Thomas, a senior sustainability planner at AECOM, told the Commission that local jurisdictions want to proactively plan for climate change, but lack funding, staff and resources to hire consultants. Planning at the regional level is more efficient than individual cities taking on the task alone. It establishes an inclusive process to coordinate various layers of governance and decisions made at the local level. Regional agencies also have greater technical capacity to understand climate change issues, Mr. Thomas said.

Witnesses at the Commission's October 24, 2013, hearing identified two additional governance models to better organize regional climate adaptation efforts and solicit funding. The Commission cites these as potential governing structures to avoid situations like that described by San Francisco International Airport, in which the airport takes all measures to prevent flooding of its runways, but continues to face flood

threats from neighboring jurisdictions. Considering these models as options for climate change adaptation may be especially critical given the rarity of such coordination to date. A 2012 research study "Effective Governance for Multi-Jurisdictional, Multi-Sector Climate Adaptation," conducted by Berkeley Law stated: "While we reviewed several useful examples of city and county adaptation planning processes, there is no clear case study that demonstrates a binding governance structure across jurisdictional lines, comprehensive or otherwise." The Commission heard often during its study process that adaptation should be incorporated into existing governing mechanisms and practices. Given that no law or state policy prevents local and regional governments from forming these governing structures, the Commission recommends further consideration at the regional level to:

- ***Create special districts for climate adaptation purposes.*** To date these are typically hazard abatement districts (shoreline erosion areas, for example) created at a regional level to manage a specific impact across jurisdictional lines. One such special district, the Broad Beach Geological Hazards Abatement District, is already in existence at Malibu's Broad Beach. Residents of beachfront homes there claim to have lost 60 feet of beach in the past decade. Approximately 114 homeowners banded together, establishing the special district to pay for beach sand to fight erosion. Florida, too, has created a form of special district known as an Adaptation Action Area. The designation, created in 2011 by the Florida State Legislature, allows local governments to create special areas considered especially vulnerable to sea level rise. The designation allows for prioritized funding for infrastructure needs. Special districts are common throughout California to provide drinking water, fire protection, parks and recreation, cemeteries, libraries, flood control and other services across jurisdictional and regional lines. They are likely to prove valuable, as well, for climate change adaptation.
- ***Create Joint Powers Authorities for climate adaptation.*** This is another variation of a special district. In a Joint Powers Authority (JPA) various government agencies agree through a legally-binding contract or memorandum of understanding to perform services mutually. Typically, a JPA can create its own staff, write its own policies, sell bonds and make decisions that cross local boundaries. One example is Alameda County's Hayward Area Shoreline Planning Agency, consisting of the Hayward Area Recreation and Park District, the City of Hayward and East Bay Regional Park District. The Hayward-area JPA is coordinating a regional response to anticipated sea level rise along more than four miles of shoreline. A key advantage of a JPA is the sense of accountability it provides to its member agencies.

Existing State Processes Can Facilitate Stronger Regional-Scale Climate Preparations

State government might motivate stronger regional-scale climate adaptation initiatives by tailoring them to state processes already in use, such as Integrated Regional Water Management (IRWM) and transportation financing. In brief, these are bottom-up processes in which locals determine and prioritize their needs, get buy-in from regional governing bodies and apply for state funding based on alignment with state goals.

Since 2008, the California Department of Water Resources (DWR) has positioned climate change adaptation within the scope of its Integrated Regional Water Management program. Bond funding channeled through DWR incentivizes local water agencies that previously operated individually, and for their own purposes, to form regional partnerships of three or more agencies for broader water management purposes. These include readying themselves for climate challenges. The IRWM process rewards flexibility and cooperation, allowing reservoir operators, for example, to move excess water during storm conditions to groundwater banking operators rather than letting it flow to the ocean.

Similarly, transportation funding in California requires cities and counties to determine transportation priorities, which then face review by regional transportation authorities or commissions. Regional authorities weigh requests in light of their broader goals and forward these packages to the state for review by the California Transportation Commission and ultimately, the Legislature.

Such public processes require governments and agencies at all levels to assess and prioritize their needs. They start, however, with agencies closest to the ground and work upward to fit into ever larger and more unified goals and policies. Such decision-making frameworks could better align climate change adaptation goals at many levels of government.

Sources: November 18, 2013, Commission staff interview with Kamyar Guivetch, manager, Division of Statewide Integrated Water Management, California Department of Water Resources. Also, Little Hoover Commission report, June 2009, Bond Spending: Expanding and Enhancing Oversight. Page 34.

Beyond Institutions: Other Climate Concerns

Beyond the realm of institutional and governing issues examined by the Commission during its study process, witnesses, participants and stakeholders raised additional climate change concerns that merit state government's attention. Fortunately, there are models and best practices already in place to begin addressing them. Ventura and El Dorado counties offer hope that larger and more frequent wildfires do not automatically mean large-scale property losses. Texas shows how coastal communities can live with a rising ocean while addressing the legal complexities of property rights. In both realms, experts and academics are already pointing toward policy directions for decision-makers. Consideration of these issues, as with all those identified earlier, lines up with a saying that has become the universal wisdom of climate adaptation: "Anticipatory adaptation is usually more effective and less costly than retrospective or emergency action."[104]

Promote Defensible Space for Wildfires

Blazing hillsides, burning homes and embattled firefighters are a defining image of California on the nightly news. Through the full season of spring, summer and ever deeper into autumn in recent years, the state's wildfires have grown in acreage, intensity and the scale of property damage. While it is difficult for scientists to see the definitive hand of climate change at work, the three largest fire years since 1950 have occurred since 2000 (2003, 2007 and 2008)," states an Office of Environmental Health Hazard Assessment report published in August 2013.[105] The California Department of Forestry and Fire Protection, Cal Fire, likewise reported in 2013 that 11 megafires in the 21st Century – all among the largest fires in California history – destroyed nearly 5,200 buildings across the state.

Commission research and testimony showed that California has great opportunity to minimize property losses as the higher temperatures and drought conditions of climate change contribute to longer, more dangerous fire seasons. The California Building Industry Association (CBIA), in particular, advocates stronger enforcement of "defensible space" statewide. Since January 2005, Public Resources Code Section 4291 requires California property owners in fire-prone areas to maintain 100 feet of defensible space around their property, or at minimum, to the outer extent of their property boundaries. But most California counties lack aggressive ongoing enforcement of the law, Robert E. Raymer, senior engineer with the CBIA, testified to the Commission.

"The provision of defensible space around a structure has a dual purpose: It reduces the potential for burning vegetation (fuel load) to come into direct contact with the structure and it provides a safer environment from which fire suppression personnel can mount a defense of the structure as a fire approaches," Mr. Raymer testified.

Mr. Raymer characterized Ventura County as a model for minimizing property damage through enforcement of defensible space. "For the past 30 years Ventura County has required property owners to remove all brush and debris within 100

Similar Success: El Dorado County

El Dorado County offers an example of providing effective defensible space in mountainous terrain increasingly populated by homes. The Fire Safe Council of El Dorado County, a non-profit public benefit corporation formed in 2001 and run by a 12-member board, describes itself as the "central driving force and forum for fire-safe projects throughout the county." In 2014 the council received a $200,000 state grant to supplement $225,000 of its own funding for education and fuel treatment. In 2012, a spokesman for the CalFire Amador-El Dorado unit testified to the role of defensible space in saving 25 homes from a fire burning in heavy brush, telling The Sacramento Bee, "Some of the homeowners had done an excellent job creating defensible space around their homes and it clearly made the difference between them returning to their home or a pile of ashes, since the fire literally burned right up to their homes."

Source: Fire Safe Council of El Dorado County. The Sacramento Bee. October 2, 2012. http://blogs.sacbee.com/crime/archives/2012/10/crews-tackle-wildland-fire-in-southern-el-dorado-county.html.

feet of their homes or be fined," he told the Commission. "For those that don't comply, there are immediate consequences," he said. "The county hires contractors to clear the land and sends the owners the bill. In addition the county adds on an administrative fee of $635.

"One way or another, they got the cleanup," he told the Commission. The building industry's Mr. Raymer pointed out that county residents have gotten the message. In 2006, the county cleared only 18 parcels, down from several hundred in the program's early years. And the county lost only 24 homes during a particularly destructive 2003 wildfire season compared to 3,600 homes in San Diego and San Bernardino counties, he said. "That was a teachable moment," he told the Commission at its February 27, 2014, hearing.

"Have other counties learned this lesson?" Mr. Raymer was asked by the Commission.

"No," he answered.

Clarify the Common Law Public Trust Doctrine

Californians in years ahead are nearly certain to witness a dramatic legal showdown between state government and owners of private oceanfront property. As the Pacific Ocean expands in volume due to climate change, rising high tides will begin to effectively "condemn" individual pieces of private property and legally convert them into public lands. Property values of expensive coastal real estate will likely tumble in such a widespread, unprecedented scenario, rallying private lawyers against government lawyers in a protracted battle over the California Constitution's Public Trust Doctrine.

The Commission believes the state would benefit strongly by seeking legal clarification in advance of this anticipated confrontation. The Governor would do well to work with the Attorney General's Office, State Lands Commission, Coastal Commission and other public and private coastal interests to begin finding a way forward before property owners begin litigating the issue in courtrooms throughout California.

California's Common Law Public Trust Doctrine is rooted in English and ancient Roman law, holding that "the air, running water, the sea and consequently the shores of the sea," are owned not by individuals, but by human kind as a whole.[106] California adopted the concept within its Constitution upon its September 9, 1850, admission to the Union. At the time no one imagined climate change and a rising ocean – the "death of stationarity" described earlier – pushing this long-established and relatively straightforward doctrine onto center stage.

Practically, the public trust doctrine means that all of the California beachfront that exists on the seaward side of the mean high tide line as it ebbs and flows is publicly owned and available for public use. The landward side of the mean high tide line is more often privately owned and off limits to the public. When an expanding and rising ocean moves inland the mean high tide line will move inland with it, converting private property to public property along 1,100 miles of coastline.

Private property owners are not expected to surrender lightly. Yet the State of California is bound by law to exercise its rights. "There is a fiduciary duty to the state to protect public assets and public property," Jennifer Lucchesi, executive officer of the State Lands Commission told the Assembly Select Committee on Sea Level Rise and the California Economy during a January 16, 2014, hearing. Likewise, California courts have over time expanded the doctrine rather than retreat from it, stated Megan M. Herzog and Sean B. Hecht of the UCLA School of Law, in a 2013 academic paper. "In its modern application in California, citizens' protected uses of trust lands and waters have expanded beyond fishing, navigation and commerce to include water-oriented recreation, scientific study, open space and environmental protection," they wrote.[107]

Inevitable Legal Conflict

Legal conflict is inevitable, California Coastal Commission Executive Director Charles Lester told the Commission on August 22, 2013. He testified, "Because common law doctrines are very fact specific, there will undoubtedly be litigation as private structures are threatened by sea level rise, and as property owners propose development in areas that may become subject to the public trust because of sea level rise." Mr. Lester said the issue may become further complicated legally as property owners try to armor their private holdings with sea walls to keep the mean high tide line at bay.

Mr. Mazmanian of USC has defined a mind-boggling array of legal and governing issues suggested by such an unexpected change in ownership rights. Could a private property owner hold government liable for failing to reduce carbon emissions and receive compensation for damages? How would a county superior court judge, lacking historical precedent beyond the "takings" issues of routine eminent domain, decide such a question? How would a city, a county or the state develop policy to manage legal public encroachment onto private property, perhaps on a massive scale? Mr. Mazmanian envisions an endlessly complex array of legal thickets:

> *"Thus it would seem that rising sea levels would effectively 'condemn' private property and convert it into public property. Would private landowners have a viable case*

under the law in bringing a lawsuit against the government for failing to take actions to mitigate climate change that thereby results in a taking of their property without just compensation? Would the private installation of a seawall be sufficient under the law to protect the landowner's private property? It would seem so on its face, but what if the property owner took such action five years after the encroachment initially took place? Could the landowner push back the sea to reclaim his property without first seeking a government permit much like someone who wants to fill in a shallow natural waterway, bay or estuary in order to 'create' new land de novo? If the landowner abandoned the flooded property, but later the sea level receded or some public project resulted in the recovery of this land as dry land, would the property owner have retained under the law some sort of contingent claim on the temporarily flooded property that the property owner could then assert? There are likely legions of such interesting legal questions that courts will likely have to grapple with, perhaps for the first time, as stationarity along the coastline disappears."[108]

The Texas Approach: Rolling Easements

Texas law employs the concept of "rolling easements" to deal with such questions. Texas is the state "most frequently associated with the rolling easement doctrine and has applied it more forcefully and for a longer period of time than any other state," according to Texas policy experts.[109] The state's 1959 Open Beaches Act defines the line where the beach ends and vegetation begins as the boundary between public and private property. When that vegetation line moves inland due to gradual erosion on the state's Gulf Coast shoreline, the state has the ability to sue property owners to remove their buildings. But recognizing the negative impact for coastal landowners, the Texas General Land Office also offers homeowners up to $50,000 to assist with relocation expenses. Using this process, the state has successfully removed 18 structures from its public beaches.[110]

The Texas rolling easement doctrine also applies to future development, providing a warning to developers that their projects risk eventual removal if the vegetation lines moves onto or past their boundaries. While this appears straightforward, legal experts maintain that "the true obstacle to implementing rolling easements and limiting wasteful coastal development is not legal, but rather, political." Among those experts, Margaret R. Caldwell, executive director of the Center for Ocean Solutions at Stanford University, has warned that "people are likely to

have unrealistic expectations about the value of their coastal property and the value of developing or remaining on it. This means that states adopting legally justified and defensible policies to limit risky coastal development may face substantial public backlash, including numerous takings claims over denied permits."[111]

Recommendation 1: The Governor should direct his administration – either through creation of a new state organization (via legislation) or delegation to an existing state entity that has capabilities to perform the mission – to establish the best state science on anticipated climate change impacts and help decision-makers accurately assess their climate risks based on that science.

- A new organization or existing entity should be advised by an independent science board to assess and establish the best possible statewide, regional and local standards by which to measure anticipated climate impacts and risks. Those standards would evolve as the scientific understanding of climate change impacts evolves.
- The organization should not make policy on climate change adaptation. It would exist to inform government regulators, land-use permitting agencies and infrastructure planners, providing the best available information and standards to guide decisions about locating or relocating development and infrastructure. State, regional and local agencies would plan to those standards, incorporating a common, consistent vision of climate change adaptation over time into all the state's planning efforts.
- Members of a new state entity, if established by legislation, should have technical expertise in climate change adaptation and be representative of state and local public- and private- sector interests throughout California. Members could serve part-time and be appointed by the Governor and require confirmation by the Senate. To maintain its independence, the new entity would not exist within the Governor's Office.
- The Governor should issue an Executive Order to mandate that state government agencies plan to the new or existing entity's standards as they are developed.

Recommendation 2: State government at all levels should further incorporate climate risk assessment into everyday public planning and governing processes throughout California.

- State government agencies should stimulate and fund more regional pilot projects such as the San Francisco Bay Conservation and Development Commission's $1.6 million "Adapting to Rising Tides" risk assessment on 26 miles of Alameda County shoreline.

- State government agencies should make climate change risk assessment an eligibility factor for all infrastructure, planning and program grants to regions. Governments at all levels should build climate risk assessment and adaptation into general plans, hazard mitigation plans and all local planning processes.
- The state should promote regional planning approaches and governing mechanisms when funding climate adaptation for cities and counties. Examples include special districts that cross jurisdictional boundaries for climate adaptation purposes, joint powers authorities and specific memorandums of understanding for multi-party adaptation projects.

Recommendation 3: The Legislature should expand the primary mission of the Strategic Growth Council beyond mitigation of greenhouse gas emissions through the SB 375 Sustainable Communities Strategy to include an equal focus on climate change adaptation in California. The Council's operating guidelines and charge to support planning and development of "sustainable communities" should stretch to include the ability to identify and address climate impacts appropriate to the community or region.

- The Legislature should incentivize and require recipients of Strategic Growth Council grants and SB 375 funding for transportation emissions reductions to build additional climate change adaptation considerations into their growth policies and climate mitigation projects.
- The Strategic Growth Council should use its responsibility to review the state's five-year infrastructure plans to foster greater emphasis on climate change adaptation in state infrastructure investments. Climate-focused reviews of statewide infrastructure investments will provide a model process and help regions and localities strengthen review of their own infrastructure investments.

Recommendation 4: State government should work with counties, private insurers, wildland stakeholders and the building industry to minimize wildfires and property damage by more aggressively enforcing defensible space requirements existing in state law. The state and stakeholders should promote Ventura County's success in enforcing compliance and reducing wildfire costs and damage as a climate change model for wildland urban interface areas.

Recommendation 5: The Governor should work with key state agencies such as the Attorney General's Office, State Lands Commission, Coastal Commission and other public and private coastal interests to clarify the impact of sea level rise on California's Common Law Public Trust Doctrine. A collective dialogue should seek ways to create a legal framework in advance of crisis and prevent litigation and instability as a rising ocean begins to condemn private property on the Pacific coastline.

The Commission's Study Process

This study represents the Commission's first look at the projected impacts of climate change on California. The year-long study process played out amid rising interest in climate adaptation within the scientific and academic community, federal, state and local government and the media. The year witnessed innumerable published reports, advances in computer modeling of potential impacts and many gatherings of experts to consider strategies and options. The Commission found great encouragement in the breadth of growing knowledge to address an uncertain future. The written testimony received during the course of this study stands among the most far-reaching available on the topic of governing issues related to climate adaptation.

The Commission's three hearings, research and interviews played out as California's state government also conducted numerous actions and studies, including preparation of an updated climate adaptation initiative to guide state agencies and decision-makers. The Legislature conducted hearings on coastal impacts of a rising Pacific Ocean. State agencies provided guidance to other California governments on sea level rise, flooding, extreme heat and other impacts, provided planning grants and prepared new general plan guidelines to assess climate impacts, convened regional leaders to share emerging practices in climate defense and built new disaster management capacity to respond to climate threats.

The Commission views its 2013-2014 study process as its foundational review of state government strategies being formulated in the face of a great uncertainty. The Commission may elect to further assess the state's evolving responses in years ahead as climate conditions become more certain and visible.

In framing this study, the Commission deliberately avoided reviewing California actions to reduce carbon emissions that contribute to global warming. Those actions, spurred by the passage of AB 32, the Global Warming Solutions Act of 2006, and governed by the California Air Resources Board, are well entrenched and the subject of much study and analysis. The Commission decided instead in early 2013 to review government preparations and potential responses to the inevitable disruptions and dislocations of climate change. Specifically, the

Commission asked how California's institutions might best govern effective statewide responses and policies. The Commission considers it critical that state government build governance structures that will deliver comprehensive solutions and avoid endless individual solutions that may prove counterproductive, as well as costly. Experts, indeed, repeatedly told the Commission that lack of governing frameworks on the scale of those in place in California to curb carbon emissions stands first among obstacles to stability.

The findings and recommendations presented in this report are based on oral and written testimony presented during three public hearings, an advisory committee meeting, extensive Commission staff research and interviews with more than 70 experts in California and elsewhere.

The Commission's first hearing on August 22, 2013, provided an overview of challenges that await a climate-changed California, including sea level rise, higher-intensity storms, hotter temperatures and sustained drought. Experts described the beginning of legal challenges and political difficulties due to sea level rise in coastal communities and noted that the state has no consensus for a statewide climate change governing strategy. They also described how government and legal institutions may hinder climate defense strategies by clinging to rules, laws and practices suited to historic, rather than future conditions.

The Commission's second hearing on October 24, 2013, examined climate change preparations at the regional level. Representatives of the state's four largest metropolitan areas – Los Angeles, San Francisco Bay Area, San Diego and Sacramento – detailed their emerging individual efforts to formulate climate adaptation strategies and their collective organizing to learn from one another and present a unified voice to state government. Witnesses described how in many cases they are ahead of the state in considering potential climate impacts and preparing for them. Witnesses described a need for more local input into state decision-making and provided numerous ideas to the Commission for government structures and strategies to foster more effective working relationships at the nexus of state, local and regional government.

A third Commission hearing on February 27, 2013, assessed preparations by the private sector for climate change impacts and detailed its need for state government to provide stability as a foundation of California's economic competitiveness with other states and nations. Experts from the state's logistics, homebuilding, land development, transportation, agricultural and energy sectors described their requirements for viable highways, ports and airports, functioning infrastructure and continuation of basic government services during disruptive flooding and climate events.

The Commission study process also included an advisory committee meeting on February 26, 2014, to explore risk assessment concepts that might be employed by state government to establish common standards for decision-making in the face of uncertainty.

Public hearing witnesses and advisory committee meeting participants are listed in the appendices.

Throughout this study, Commission staff received much valuable input from interviews with experts at the forefront of climate change adaptation in the United States and globally. These included specialists in the fields of environmental science, disaster law, urban planning and development, public administration, emergency and risk management, transportation, energy and insurance. All gave generously of their time, providing great benefit to the Commission. The findings and recommendations in the report, however, are the Commission's own.

Appendices & Notes

- ✓ ***Public Hearing Witnesses***
- ✓ ***Little Hoover Commission Public Meeting***
- ✓ ***Significant State Government Research Initiatives Since 2006***
- ✓ ***Cover Photo Credits***
- ✓ ***Notes***

Appendix A

Public Hearing Witnesses

The lists below reflect the titles and positions of witnesses at the time of the hearings during 2013 and 2014.

Public Hearing on Climate Change Adaptation
August 22, 2013
Sacramento, California

Stephen G. Bushnell, Senior Director, Fireman's Fund Insurance Company

Ann C. Chan, Deputy Secretary for Climate Change and Energy, California Natural Resources Agency

Charles Lester, Executive Director, California Coastal Commission

Daniel Mazmanian, Public Policy Professor, Sol Price School of Public Policy, University of Southern California

Susanne Moser, Director and Principal Researcher, Susanne Moser Research & Consulting

Robert Verchick, Gauthier-St. Martin Chair in Environmental Law, Loyola University, New Orleans

Public Hearing on Climate Change Adaptation
October 24, 2013
Sacramento, California

Larry Goldzband, Executive Director, San Francisco Bay Conservation and Development Commission

Larry Greene, Executive Director/Air Pollution Control Officer, Sacramento Metropolitan Air Quality Management District

Alex Hall, Professor, Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles

Krista Kline, Managing Director, Los Angeles Regional Collaborative for Climate Action and Sustainability

Kate Meis, Executive Director, Local Government Commission

Jonathan Parfrey, Executive Director, Climate Resolve

Bruce Riordan, Climate Strategist, Bay Area Joint Policy Committee, and Chair, Alliance of Regional Collaboratives for Climate Adaptation

R. Zachary Wasserman, Chair, San Francisco Bay Conservation and Development Commission

Emily Young, Vice President, Environment Initiatives, The San Diego Foundation

Public Hearing on Climate Change Adaptation
February 27, 2014
Sacramento, California

Robert B. Anderson, Director, Resource Planning, San Diego Gas & Electric

Joe Birrer, Principal Engineer, Design, Construction and Technology, San Francisco International Airport

Jamie Exon, Manager, Electric Distribution Operations – Major Projects, San Diego Gas & Electric

T.L. Garrett, Vice President, Pacific Merchant Shipping Association

Jeffrey Goldman, Principal, AECOM

Richard Lyon, Senior Vice President, Public Policy, California Building Industry Association

Michael Mielke, Vice President, Environmental Policy and Programs, Silicon Valley Leadership Group

Joel Nelsen, President and Chief Executive Officer, California Citrus Mutual

Robert Raymer, Senior Engineer and Technical Director, California Building Industry Association

Appendix B

Little Hoover Commission Public Meeting

Advisory Committee Meeting on
the Role of Risk Assessment in Climate Change Adaptation
February 26, 2014
Sacramento, California

Diane Colborn, Chief Consultant, Assembly Committee on Water, Parks and Wildlife

Christina Curry, Deputy Director, California Governor's Office of Emergency Services

Edward Curtis, Senior Civil Engineer, Risk Analysis Branch, Federal Emergency Management Agency, Region IX

Larry Goldzband, Executive Director, San Francisco Bay Conservation and Development Commission

Melissa Higbee, Program Officer, ICLEI – Local Governments for Sustainability USA

Jose Lara, Division Chief, Hazard Mitigation Planning Division, California Governor's Office of Emergency Management

Edith Lohmann, Insurance Specialist, National Flood Insurance Program, Federal Emergency Management Agency, Region IX

Tim McCrink, Supervising Engineering Geologist, California Geological Survey

Jaime Michaels, Principal Permit Analyst, San Francisco Bay Conservation and Development Commission

David Michel, Local Energy and Land Use Assistance Manager, California Energy Commission

Julie Norris, Senior Emergency Services Coordinator, Hazard Mitigation Planning Division, California Governor's Office of Emergency Services

Diane Ross-Leech, Director, Environmental Policy, Pacific Gas and Electric Company

Bill Short, Supervising Engineering Geologist and Program Manager, Forest and Watershed Geology Program, California Geological Survey

Culley Thomas, Senior Sustainability Planner, AECOM

Appendix C

Significant State Government Research Initiatives Since 2006

State government agencies have invested considerable effort in studying climate change and how it might affect California residents, natural areas, water supplies and wildlife. State government also has provided extensive guidance to local governments about how to plan and begin thinking about responses. A dozen highlights of significant work:

2006

The First Climate Assessment prepared through the California Energy Commission's Public Interest Energy Research program examined potential impacts of climate change on key state resources such as water supplies, public health, agriculture, coastal areas, forestry and electricity production and demand. The assessment influenced passage of Assembly Bill 32, the Global Warming Solutions Act of 2006.

2009

The Second Climate Change Assessment provided initial estimates of the economic impacts of climate change. It concluded that adaptation - as a complementary approach to mitigation - could substantially reduce economic impacts of loss and damage from a changing climate. Findings from the Second Assessment were instrumental in preparing the 2009 California Climate Adaptation Strategy.

The State Lands Commission examined coastal issues in an analysis titled, "A Report on Sea Level Rise Preparedness." The Commission, which holds authority over the three-mile-wide band of tidal and submerged lands next to the California coast and offshore islands, recommended an inventory of its existing leases to identify infrastructure vulnerable to sea level rise of up to 55 inches. It also recommended that coastal development projects under its jurisdiction build sea level rise adaptation strategies into the plans.

2011

Caltrans produced "Guidance on Incorporating Sea Level Rise" for department planners to help determine if sea level rise should be addressed in specific infrastructure projects and if so, how to incorporate it.

2012

The Natural Resources Agency and California Emergency Management Agency (now the Governor's Office of Emergency Services) jointly issued the "California Adaptation Planning Guide" to help local and regional planners address potential climate damage in their jurisdictions. The package of four reports provided the first "step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development."

The Third Climate Change Assessment expanded and updated state government analysis of potential threats to California and offered 30 additional reports from University of California researchers identifying threats and potential solutions. They also provided a first look at regional climate impact scenarios in Oakland, the Bay Area, San Luis Obispo and Santa Barbara.

2013

Caltrans released "Addressing Climate Change Adaptation in Regional Transportation Plans: A Guide for California MPOs and RTPAs." The report aimed to help the state's metropolitan planning organizations and regional transportation planning agencies begin preparing regionally for climate change.

The Office of Environmental Health Hazard Assessment released "Indicators of Climate Change in California," a compilation of climate impacts expected on California's environment and human population.

The California Department of Public Health published "Preparing Californians for Extreme Heat: Guidance and Recommendations," its updated extreme heat guidance to public health agencies statewide.

The Governor's Office of Planning and Research released a draft of its Environmental Goals and Policy Report, "California @50 Million. California's Climate Future." The draft examined California's future through the lens of decarbonizing the economy and adapting to climate change.

The California Coastal Commission released its "Draft Sea Level Rise Policy Guidance," a detailed guide to local governments fronting the Pacific Coastline on how to factor sea level rise into land use planning.

The California Energy Commission released "Climate Change and the Energy Sector," a detailed review of energy generation and transmission issues as potentially impacted by climate change.

Appendix D

Cover Photo Credits

Cover Photo Credits: Courtesy of Governor's Office of Emergency Services – State of California. Also, Jack Sutton, courtesy of California King Tides Project.

Notes

1. Paul Rogers. October 29, 2013. "Climate change pact signed by California, Oregon, Washington and British Columbia." The San Jose Mercury News. http://www.mercurynews.com/science/ci_24406734/california-oregon-washington-and-british-columbia-sign-climate?source=email. Accessed December 16, 2013.

2. Rockefeller Foundation. December 2013. "About the Challenge." New York, N.Y. http://100resilientcities.rockefellerfoundation.org/pages/about-the-challenge. Accessed December 20, 2013.

3. Pacific Council on International Policy. November 22, 2010. "Preparing for the Effects of Climate Change – A Strategy for California. A Report by the California Adaptation Advisory Panel to the State of California." Los Angeles, CA. http://www.pacificcouncil.org/document.doc?id=183. Accessed December 23, 2013.

4. Daniel Mazmanian. Public Policy Professor. Sol Price School of Public Policy. University of Southern California. Los Angeles, CA. August 22, 2013. Written testimony to the Commission.

5. California Climate Change Center. July 2012. "Our Changing Climate. 2012. Vulnerability & Adaptation to the Increasing Risks from Climate Change in California." Pages 2-14. Sacramento, CA. http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf. Accessed March 13, 2014.

6. California Natural Resources Agency. 2009. "2009 California Climate Adaptation Strategy. A Report to the Governor of the State of California in Response to Executive Order S-13-2008." Sacramento, CA. http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf. Accessed December 23, 2013.

7. Robert Sanders. Media relations. University of California at Berkeley News Center. August 1, 2012. "State taps UC researchers for expertise on climate change impacts." Berkeley, CA. http://newscenter.berkeley.edu/2012/08/01/state-taps-uc-researchers-for-expertise-on-climate-change-impact. Accessed December 23, 2013.

8. Mimi Hughes, Alex Hall, and Jinwon Kim. University of California at Los Angeles. March 2009. "Anthropogenic Reduction of the Santa Ana Winds. A Paper From: California Climate Change Center." Los Angeles, CA. http://www.energy.ca.gov/2009publications/CEC-500-2009-015/CEC-500-2009-015-D. Accessed December 23, 2013.

9. Resource Legacy Fund. January 2013. "Ecosystem Adaptation to Climate Change in California. Nine Guiding Principles." Page 7. Sacramento, CA. http://www.resourceslegacyfund.org/images/pdfs/Guiding_Principles_Brochure.PDF. Accessed December 23, 2013.

10. David Stoms, Guido Franco, Heather Raitt, Susan Wilhelm, Sekita Grant. December 2013. "Climate Change and the California Energy Sector." Page 5. Sacramento, CA. http://www.energy.ca.gov/2013publications/CEC-100-2013-002/CEC-100-2013-002.pdf. Accessed December 26, 2013.

11. National Oceanic and Atmospheric Administration. National Climatic Data Center. December 2013. "Global Analysis – Annual 2013." Washington, D.C. http://www.ncdc.noaa.gov/sotc/global/2013/13. Accessed March 26, 2014.

12. California Climate Change Center. August 2012. "Our Changing Climate 2012, Vulnerability & Adaptation to the Increasing Risks from Climate Change in California." Page 2. Sacramento, CA. http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf. Accessed July 29, 2013.

13. Alex Hall, Ph.D. June 2012. "Mid-Century Warming in the Los Angeles Region." Los Angeles, CA. http://c-change.la/temperature. Accessed December 26, 2013.

14. Alex Hall, Ph.D. June 2012. "Mid-century warming in the Los Angeles region. Climate Change. Los Angeles Temperature Study. FAQ." Page 3. Los Angeles, CA. http://c-change.la/pdf/faq.pdf. Accessed March 6, 2014.

15. Daniel Farber. Sho Sato Professor of Law and Chair, Energy and Resources Group. University of California, Berkeley. December 20, 2011. "Navigating the Intersection of Environmental Law and Disaster Law." Berkeley, CA. http://scholarship.law.berkeley.edu/cgi/viewcontent.cgi?article=3059&context=facpubs. Accessed March 28, 2014.

16. Paul Rogers. August 8, 2013. "Global warming already having dramatic impacts in California, new report says." San Jose Mercury News. http://www.mercurynews.com/science/ci_23819150/global-warming-already-having-dramatic-impacts-california-new. Accessed April 21, 2014.

17. Alex Hall, Ph.D. June 2013. "Mid and End-of-Century Snowfall in the Los Angeles Region." Los Angeles, CA. http://c-change.la/snowfall. Accessed March 6, 2014.

18. Department of Water Resources. October 2008. "Managing an Uncertain Future. Climate Change Adaptation Strategies for California's Water." Page 4. Sacramento, CA. http://www.water.ca.gov/climatechange/docs/ClimateChangeWhitePaper.pdf. Accessed March 21, 2014.

19. John Maulbetsch. Principal investigator. Maulbetsch Consulting. California Energy Commission. June 4, 2014. Sacramento, CA. "Climate Change and the Energy Sector" workshop.

20. Gary Freeman. Principal Hydrologist. Pacific Gas and Electric Co. Presentation to Capital Region Climate Readiness Collaborative. September 12, 2014. Sacramento, CA.

21. California Department of Food and Agriculture. October 3, 2013." Climate Change Consortium for Specialty Crops: Impacts and Strategies for Resilience." Page 11. Sacramento, CA. http://www.cdfa.ca.gov/egov/press_releases/Press_Release.asp?PRnum=13-032. Accessed January 27, 2014.

22. California Department of Food and Agriculture. Page 7. See endnote 21.

23. Proceedings of the National Academy of Sciences. February 19, 2013. "Climate change, wine, and conservation." Washington, D.C. http://www.conservation.org/Documents/CI_PNAS_Climate-Change-Wine-production-Conservation_Lee-Hannah_March-2013.pdf. Accessed January 27, 2014.

24. Steve Gorman. December 12, 2012. "Deep freeze damages California citrus crop." Reuters. http://www.reuters.com/article/2013/12/12/usa-citrus-california-idUSL1N0JR01X20131212. Accessed January 27, 2014.

25. California Natural Resources Agency. Page 3. See endnote 6.

26. National Research Council. 2012. "Report in Brief: Sea Level Rise for the Coasts of California, Oregon and Washington: Past, Present and Future." Page 3. Washington, D.C. http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/sea-level-rise-brief-final.pdf. Accessed May 7, 2013.

27. Pacific Council on International Policy. Page 10. See endnote 3.

28. Matthew Heberger, Heather Cooley, Pablo Herrera, Peter H. Gleick and Eli Moore of the Pacific Institute. May 2009. "The Impacts of Sea Level Rise on the California Coast. A Paper From California Climate Change Center." Pages 1-2. San Francisco, CA. http://www.pacinst.org/wp-content/uploads/2013/02/report16.pdf. Accessed December 24, 2013.

29. Megan M. Herzog. UCLA Emmett/Frankel Fellow in Environmental Law and Policy. UCLA School of Law. Sean B. Hecht. Executive Director. Environmental Law Center. Director. Evan Frankel Environmental Law and Policy Program. UCLA School of Law. 2013. "Combatting Sea Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk." Page 7. Los Angeles, CA. https://www.usc.edu/org/seagrant/Publications/PDFs/HerzogHechtCombating%20Sea-LevelRiseinSouthernCalifornia2013.pdf. Accessed April 18, 2014.

30. County of Santa Barbara Planning and Development. Santa Barbara, CA. http://www.sbcountyplanning.org/projects/11DVP-00000-00016. Accessed February 6, 2014.

31. National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management. October 22, 2007. "Managed Retreat Strategies: Case Studies." Washington, D.C. http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html. Accessed February 6, 2014.

32. Tony Barboza. January 16, 2011. "In Ventura, a retreat in the face of a rising sea." Los Angeles Times. http://articles.latimes.com/2011/jan/16/local/la-me-surfers-point-20110116. Accessed February 6, 2014.

33. Pacifica State Beach Adopts Managed Retreat Strategy. U.S. Department of Commerce - Ocean & Coastal Resource Management. Washington, D.C. http://coastalmanagement.noaa.gov/initiatives/shoreline_ppr_retreat.html. Accessed February 6, 2014.

34. San Francisco Planning and Urban Research Association. May 21, 2012. "Ocean Beach Master Plan: A comprehensive vision for a more sustainable future on San Francisco's Pacific Coast." San Francisco, CA http://www.spur.org/publications/spur-report/2012-05-21/ocean-beach-master-plan. Accessed February 6, 2014.

35. The City of New York. June 11, 2013. "A Stronger More Resilient New York." Pages 11-17. New York, NY. http://nytelecom.vo.llnwd.net/o15/agencies/sirr/SIRR_singles_Hi_res.pdf. Accessed January 27, 2014.

36. Susanne Moser. Principal Researcher and Director. Susanne Moser Research and Consulting. Santa Cruz, CA. August 22, 2013. Written testimony to the Commission.

37. Ben Chou. April 2012. "Ready or Not: An Evaluation of State Climate and Water Preparedness Planning." Page 7-8. New York, NY. National Resources Defense Council. http://www.nrdc.org/water/readiness/water-readiness-report.asp. Accessed May 8, 2013.

38. Patrick Kemp. Assistant Secretary for Finance/Administration. California Natural Resources Agency. Sacramento, CA. June 16, 2014. Written Communication.

39. State of Hawaii. House of Representatives. Twenty-seventh Legislature 2014. "H.B. No. 1714." Honolulu, HI. http://www.capitol.hawaii.gov/measure_indiv.aspx?billtype=HB&billnumber=1714&year=2014. Accessed June 16, 2014.

40. California Coastal Conservancy. "Climate Ready Projects to Help Coastal Communities Adapt to Climate Change." Sacramento, CA. http://scc.ca.gov/2014/01/23/climate-ready-grant-round-top-ranked-projects-announced/#more-2963. Accessed April 1, 2014.

41. Inter-governmental Panel on Climate Change. March 31, 2014. "Climate Change 2014: Impacts, Adaptation, and Vulnerability. SUMMARY FOR POLICYMAKERS." Page 8. Yokohama, Japan. http://ipcc-wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf. Accessed April 1, 2014.

42. Michael McCormick. Senior planner and local and regional affairs adviser. Governor's Office of Planning and Research. Sacramento, CA. August 21, 2013. Personal communication.

43. County of Los Angeles. "About LA County." Los Angeles, CA. http://www.lacounty.gov/wps/portal/lac/about. Accessed October 1, 2013.

44. Los Angeles Regional Collaborative for Climate Action and Sustainability. "A Greater Los Angeles." Los Angeles, CA. http://www.laregionalcollaborative.com/agla. Accessed June 30, 2014.

45. Climate Resolve. March 28, 2013. "Climate Resolve: Inspiring LA to Prosper in a Changing Climate." Los Angeles, CA. http://maker.good.is/projects/climateresolve. Accessed September 26, 2013.

46. Climate Resolve. 2013. "Mission Statement." Los Angeles, CA. http://climateresolve.org/mission-statement. Accessed October 3, 2013.

47. Bay Area Climate & Energy Resilience Project. March 2013. "Stakeholder Interview Summary. Key Findings & Selected Projects." Page 12. Oakland, CA. http://cakex.org/sites/default/files/documents/Task%207b%20Stakeholder%20Input.pdf. Accessed September 26, 2013.

48. University of California, Berkeley. Susanne Moser Research & Consulting. Stanford University. July 2012. "Climate Change Impacts, Vulnerabilities, and Adaptation in the San Francisco Bay Area." Page 10. Sacramento, CA. http://www.energy.ca.gov/2012publications/CEC-500-2012-071/CEC-500-2012-071.pdf. Accessed September 26, 2013.

49. San Francisco Bay Conservation and Development Commission. October 6, 2011. "Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline." Page 3. San Francisco, CA. http://www.bcdc.ca.gov/BPA/LivingWithRisingBay.pdf. Accessed September 26, 2013.

50. Bruce Riordan. Climate Strategist. The Joint Policy Committee. San Francisco, CA. July 19, 2013. Written communication.

51. Alameda Elder Communities. September 25, 2013. "Success at the BCDC Hearing!" Oakland, CA. http://www.phoenixcommons.com/success-at-the-bdcd-hearing. Accessed September 26, 2013.

52. The San Diego Foundation. November 8, 2012. "Consolidated Financial Statements. Years ended, June 30, 2012 and 2011." Page 4. San Diego, CA. http://www.sdfoundation.org/Portals/0/Howtogive/PDF/AuditedFinancialFY2012TSDF.pdf. Accessed September 20, 2013.

53. The San Diego Foundation. January 18, 2013. "Climate Action Planning Progress in the San Diego Region." Page 3. San Diego, CA. http://www.sdfoundation.org/Portals/0/Newsroom/PDF/Reports/ClimateActionPlanning.pdf. Accessed September 20, 2013.

54. Alan Boyle. Science Editor. February 18, 2006. "Next New Orleans' may be in California. Sacramento- San Joaquin Delta cited as 'scariest spot' for flooding." NBCNews.com. http://www.nbcnews.com/id/11427817/ns/technology_and_science-science/t/next-new-orleans-may-be-california/#.UkG8ANKsh8E. Accessed September 24, 2013.

55. Capital Region Climate Readiness Collaborative. September 12, 2013. "Climate Change Risks and Solutions for the Sacramento Region." Page 5. Sacramento, CA. On file.

56. Jeff Goodell. June 20, 2013. "Goodbye, Miami." Rolling Stone. http://www.rollingstone.com/politics/news/why-the-city-of-miami-is-doomed-to-drown-20130620. Accessed March 18, 2014.

57. Weissman, S., Varghese, S. and Wood, Z. April 1, 2013. "Effective Governance for Multi-Jurisdictional, Multi-Sector Climate Adaptation." University of California, Center for Law, Energy and the Environment. Page 14. Berkeley, CA. http://www.abag.ca.gov/jointpolicy/pdfs/Task%207c4%20Decision%20Making.pdf. Accessed March 8, 2014.

58. Southeast Florida Regional Climate Change Compact Counties. October 2012. "Regional Climate Action Plan: A Region Responds to a Changing Climate." http://www.miamidade.gov/oos/library/2011_climate_action_draft.pdf. Accessed March 18, 2014.

59. Weissman, S., Varghese, S. and Wood, Z. Page 15. See endnote 56.

60. Southeast Florida Regional Climate Change Compact Counties. Page 12. See endnote 58.

61. State of Oregon. December 2010. "The Oregon Climate Change Adaptation Framework." Salem, OR. http://www.oregon.gov/ENERGY/GBLWRM/docs/Framework_Final_DLCD.pdf. Accessed March 19, 2014.

62. Department of Ecology, State of Washington. April 2012. "Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy." Pages 12, 19. Olympia, WA. https://fortress.wa.gov/ecy/publications/publications/1201004.pdf. Accessed March 19, 2014.

63. Intergovernmental Panel on Climate Change. 2012. "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation." New York, NY. Cambridge University Press. http://ipcc-wg2.gov/SREX/images/uploads/SREX-All_FINAL.pdf. Accessed March 18, 2014.

64. National Oceanic and Atmospheric Administration. May 6, 2014. "Obama Administration releases Third National Climate Assessment for the United States." Washington, D.C. http://www.noaanews.noaa.gov/stories2014/20140506_climateassessment.html. Accessed May 29, 2014.

65. The White House. Executive Office of the President. June 2013. "The President's Climate Action Plan." Washington, D.C. http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf. Accessed March 17, 2014.

66. Green InfoNetwork. California Protected Lands Data Portal. San Francisco, CA. http://www.calands.org/data/statistics. Accessed March 17, 2014.

67. Susanne Moser. See footnote 36.

68. The White House. Office of the Press Secretary. November 1, 2013. "Fact Sheet: Executive Order on Climate Preparedness." Washington, D.C. http://www.whitehouse.gov/the-press-office/2013/11/01/fact-sheet-executive-order-climate-preparedness. Accessed March 17, 2014.

69. Resilient Communities for America. "Agreement Signatories." Oakland, CA. http://www.resilientamerica.org/join-the-leaders/view-the-signatories. Accessed April 7, 2014.

70. Dean Scott. March 5, 2014. "Will $1 Billion Help Regions Prepare for the Impacts of Climate Change? Yes, According to President Obama." Bloomberg BNA. http://www.bna.com/billion-help-regions-b17179882618. Accessed March 18, 2014.

71. President Barack Obama. June 14, 2014. Speech to graduating class of University of California, Irvine. Anaheim, CA. http://www.whitehouse.gov/the-press-office/2014/06/13/remarks-president-university-california-irvine-commencement-ceremony. Accessed June 16, 2014.

72. The White House. Office of the Press Secretary. June 14, 2014. "Fact Sheet: National Disaster Resilience Competition." Washington, D.C. http://www.whitehouse.gov/the-press-office/2014/06/14/fact-sheet-national-disaster-resilience-competition. Accessed June 16, 2014.

73. California Business Roundtable. Pepperdine University School of Public Policy. May 2, 2013. "Issue Survey Series 2013." http://www.cbrt.org/california-business-roundtable-and-pepperdine-university-release-full-results-of-californians-views-on-energy-and-the-environment. Accessed May 10, 2013.

74. Public Policy Institute of California. May 2014. "PPIC Statewide Survey. Californians and Their Government." San Francisco, CA. http://www.ppic.org/content/pubs/survey/S_514MBS.pdf. Accessed June 3, 2014.

75. California Climate Change Center. July 2012. "Our Changing Climate 2012. Vulnerability & Adaption to the Increasing Risks from Climate Change in California." Page 9. Sacramento, CA. http://www.energy.ca.gov/2012publications/CEC-500-2012-007/CEC-500-2012-007.pdf. Accessed May 10, 2013.

76. Charles Lester. Executive Director. California Coastal Commission. San Francisco, CA. August 22, 2013. Written testimony to the Commission.

77. Maximillian Auffhammer. Associate Professor. University of California at Berkeley. May 19, 2014. Giannini Foundation of Agricultural Economics. University of California at Davis. Sacramento, CA. "Climate Change: Challenges to California's Agriculture and Natural Resources."

78. Daniel A. Mazmanian, John Jurewitz and Hal Nelson. March 22-23, 2012. "In Search of a Robust Strategy for Governing Climate Change Adaptation." Pages 4-14. http://www.adaptgov.com/wp-content/uploads/2012/03/Mazmanian-Jurewitz-Nelson-Governing-Adaptation-Amsterdam-Symposium-FINAL-3-10-12.pdf. Accessed March 12, 2014.

79. Daniel A. Mazmanian, John Jurewitz and Hal Nelson. Pages 9 and 12. See endnote 78.

80. Susanne Moser. 2009. "Governance and the Art of Overcoming Barriers to Adaptation." http://www.ehs.unu.edu/file/get/7204.pdf. Accessed March 13, 2014.

81. Joe Birrer. Principal Engineer, Design, Construction and Technology. San Francisco International Airport. San Francisco, CA. February 27, 2014. Written Testimony to the Commission.

82. Susanne Moser. Director and Principal Researcher. Susanne Moser Research & Consulting. Santa Cruz, CA. August 22, 2013. Testimony to Little Hoover Commission. Sacramento, CA.

83. Kia Gregory and Marc Santora. June 11, 2013. "Bloomberg Outlines $20 Billion Storm Plan Protection Plan." The New York Times. http://www.nytimes.com/2013/06/12/nyregion/bloomberg-outlines-20-billion-plan-to-protect-city-from-future-storms.html?pagewanted=all&_r=0. Accessed March 18, 2014.

84. New York City Economic Development Corporation. January 29, 2014. New York, N.Y. http://www.nycedc.com/press-release/nycedc-announces-launch-30-million-competition-help-small-businesses-become-more. Accessed March 18, 2014.

85. The Pacific Council on International Policy. Pages 5-8. See endnote 3.

86. Kate Meis. Executive Director. Local Government Commission. Sacramento, CA. October 24, 2013. Written testimony to the Commission.

87. The Pacific Council on International Policy. Pages 21 and 27. See endnote 3.

88. Ocean Protection Council. November 21, 2013. Agenda Item 6. "Staff Recommendation." Sacramento, CA. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20131121/Item6-OPC-Nov2013-Staff-Rec-LCP-grant.pdf. Accessed April 4, 2014.

89. Office of Environmental Health Hazard Assessment. "OEHHA Department Description." Sacramento, CA. http://www.oehha.ca.gov/about/description.html. Accessed May 21, 2014.

90. Office of Environmental Health Hazard Assessment. "CALENVIROSCREEN VERSION 2.0 DRAFT AND WEBINAR." Sacramento, CA. http://oehha.ca.gov/ej/ces2.html. Accessed May 21, 2014.

91. Office of Environmental health Hazard Assessment. August 2013. "Indicators of Climate Change in California." Sacramento, CA. http://www.oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsReport2013.pdf. Accessed May 21, 2014.

92. Gail Sullivan. May 19, 2014. "Climate change: Get ready or get sued." The Washington Post. http://www.washingtonpost.com/news/morning-mix/wp/2014/05/19/climate-change-get-ready-or-get-sued. Accessed May 28, 2014.

93. Robert McCoppin. June 3, 2014. "Insurance company drops suits over Chicago-area flooding." The Chicago Tribune. http://www.chicagotribune.com/news/local/breaking/chi-chicago-flooding-insurance-lawsuit-20140603,0,6767298.story. Accessed June 4, 2014.

94. Mica Rosenberg. May 19, 2014. "Insurer's Climate Change Class Actions: More to Come?" The Insurance Journal. http://www.insurancejournal.com/news/national/2014/05/19/329506.htm. Accessed May 28, 2014.

95. The H. John Heinz III Center for Science, Economics and the Environment. Ceres. 2009. "Resilient Coasts: A Blueprint for Action." Page 6. Washington, D.C. http://www.ceres.org/resources/reports/resilient-coasts-blueprint-for-action-2009. Accessed August 5, 2013.

96. Franklin W. Nutter. President. Reinsurance Association of America. "Climate Change. It's Happening Now." Testimony July 18, 2013, before the U.S. Senate Committee on Environment and Public Works. Washington, D.C. http://www.reinsurance.org/RAA/News/July_2013/Nutter_Testifies_at_Senate_Hearing_on_Climate_Change. Accessed August 5, 2013.

97. Edith Lohman, Insurance Specialist. National Flood Insurance Program. Federal Emergency Management Agency. Region IX. Oakland, CA. July 24, 2013. Personal communication.

98. Sean P. Hecht. Executive Director. UCLA Environmental Law Center. September 17, 2012. "Insurance." Chapter 14 of "The Law of Adaptation to Climate Change. U.S. and International Aspects." The American Bar Association. Pages 512 and 524. Chicago, Ill. On file.

99. Rong Gong Lin II, Rosanna Xia and Doug Smith. January 9, 2014. "Gov. Brown calls for more funding to map earthquake faults." The Los Angeles Times. Los Angeles, CA. http://articles.latimes.com/2014/jan/09/local/la-me-quake-budget-20140110. Accessed February 6, 2014.

100. Daniel A. Mazmanian, John Jurewitz and Hal Nelson. Page 14. See endnote 78.

101. California Strategic Growth Council. July 1, 2013. "2013 Annual Report to the Legislature." Page 8-9. Sacramento, CA. http://www.sgc.ca.gov/docs/workplan/SGC-2013-AnnualReport.pdf. Accessed March 23, 2014.

102. California Strategic Growth Council. December 6, 2013. "Grant Guidelines & Application: 2013 Request for Proposals." Sustainable Communities Planning Grant and Incentives Program. Page 3. Sacramento, CA. http://sgc.ca.gov/docs/Grant_Guidelines_and_Application_2013_Solicitation.pdf. Accessed March 8, 2014.

103. California Strategic Growth Council. June 29, 2012. "2012 Annual Report to the Legislature." Page 3. Sacramento, CA. http://sgc.ca.gov/docs/SGC-2012-AnnualReport.pdf. Accessed March 8, 2014.

104. Greater London Authority. February 2010. "The draft climate change adaptation strategy for London." Page 19. London, United Kingdom. http://www.london.gov.uk/sites/default/files/Draft_Climate_Change_Adaptation_Strategy.pdf. Accessed July 7, 2014.

105. Office of Environmental Health Hazard Assessment. August 2013. "Indicators of Climate Change in California." Sacramento, CA. http://oehha.ca.gov/multimedia/epic/pdf/ClimateChangeIndicatorsReport2013.pdf Accessed April 17, 2014.

106. Helen Althaus. 1978. "Public Trust Rights." U.S. Department of the Interior. Pages 1-2. http://trove.nla.gov.au/work/35128699?selectedversion=NBD42407137. Cited by California State Lands Commission. December 2009. "A Report on Sea Level Rise Preparedness." Page 24. Sacramento, CA. http://www.slc.ca.gov/reports/sea_level_report.pdf. Accessed April 17, 2014.

107. Megan M. Herzog and Sean B. Hecht. Page 12. See endnote 29.

108. Daniel A. Mazmanian, John Jurewitz and Hal Nelson. Page 14. See endnote 78.

109. Richard J. McLaughlin. Endowed Chair for Marine Policy and Law. Harte Research Institute for Gulf of Mexico Studies. Texas A&M University-Corpus Christi. Spring, 2011. "Rolling easements as a response to sea level rise in coastal Texas: current status of the law after Severance v. Patterson." Page 369. Corpus Christi, TX. http://www.cakex.org/sites/default/files/documents/mclaughlin.pdf. Accessed April 18, 2014.

110. Jerry Patterson. Texas Land Commissioner. Texas General Land Office. 2014. "Open Beaches." Austin, TX. http://www.glo.texas.gov/what-we-do/caring-for-the-coast/open-beaches. Accessed April 18, 2014.

111. Margaret E. Peloso. Associate Vinson & Elkins, LLP. Ph.D. 2010. Duke University. JD 2009. Stanford Law School. Margaret R. Caldwell. Executive Director. Center for Ocean Solutions. Director. Environmental and Natural Resources Law and Policy Program. Stanford Law School. March 2011. "Dynamic Property Rights: The Public Trust Doctrine and Takings in a Changing Climate." Pages 1-7, 108. Palo Alto, CA. http://media.law.stanford.edu/publications/archive/pdf/H_Peloso_Caldwell%20with%20appendix2.pdf. Accessed April 18, 2014.

Little Hoover Commission Members

Chairman Pedro Nava *(D-Santa Barbara)* Appointed to the Commission by Speaker of the Assembly John Pérez in April 2013. Advisor to telecommunications industry on environmental and regulatory issues and to nonprofit organizations. Former state Assemblymember. Former civil litigator, deputy district attorney and member of the state Coastal Commission. Elected chair of the Commission in March 2014.

Vice Chairman Loren Kaye *(R-Sacramento)* Appointed to the Commission by Governor Arnold Schwarzenegger in March 2006 and reappointed by Governor Schwarzenegger in December 2010. President of the California Foundation for Commerce and Education. Former partner at KP Public Affairs. Served in senior policy positions for Governors Pete Wilson and George Deukmejian, including cabinet secretary to the Governor and undersecretary for the California Trade and Commerce Agency.

Assemblymember Katcho Achadjian *(R-San Luis Obispo)* Appointed to the Commission by Speaker of the Assembly John Pérez in July 2011. Elected in November 2010 to the 33rd Assembly District and re-elected to the 35th District in November 2012. Represents Arroyo Grande, Atascadero, Grover Beach, Guadalupe, Lompoc, Morrow Bay, Paso Robles, Pismo Beach, San Luis Obispo, Santa Maria and surrounding areas.

David Beier *(D-San Francisco)* Appointed to the Commission by Governor Edmund G. Brown, Jr. in June 2014. Managing director of Bay City Capital. Former senior officer of Genetech and Amgen. Former counsel to the U.S. House of Representatives Committee on the Judiciary. Serves on the board of directors for the Constitution Project.

Senator Anthony Cannella *(R-Ceres)* Appointed to the Commission by the Senate Rules Committee in January 2014. Elected in November 2010 to the 12th Senate District. Represents Stanislaus, Merced, Madera and San Benito counties and a portion of Monterey County.

Jack Flanigan *(R-Granite Bay)* Appointed to the Commission by Governor Edmund G. Brown, Jr. in April 2012. A member of the Flanigan Law Firm. Co-founded California Strategies, a public affairs consulting firm, in 1997.

Don Perata *(D-Orinda)* Appointed to the Commission by Senate Rules Committee in February 2014. Political consultant. Former president pro tempore of the state Senate, from 2004 to 2008. Former Assemblymember, Alameda County supervisor and high school teacher.

Assemblymember Anthony Rendon *(D-Lynwood)* Appointed to the Commission by Speaker of the Assembly John Pérez in February 2013. Elected in November 2012 to represent the 63rd Assembly District. Represents Bell, Cudahy, Hawaiian Gardens, Lakewood, Lynwood, Maywood, Paramount and South Gate and the North Long Beach community.

Senator Richard Roth *(D-Riverside)* Appointed to the Commission by the Senate Rules Committee in February 2013. Elected in November 2012 to the 31st Senate District, representing Corona, Coronita, Eastvale, El Cerrito, Highgrove, Home Gardens, Jurupa Valley, March Air Reserve Base, Mead Valley, Moreno Valley, Norco, Perris and Riverside.

David A. Schwarz *(R-Beverly Hills)* Appointed to the Commission by Governor Arnold Schwarzenegger in October 2007 and reappointed by Governor Schwarzenegger in December 2010. Partner in the Los Angeles office of Irell & Manella LLP and a member of the firm's litigation workgroup. Former U.S. delegate to the United Nations Human Rights Commission.

Jonathan Shapiro *(D-Beverly Hills)* Appointed to the Commission by the Senate Rules Committee in April 2010 and reappointed by the Senate Rules Committee in January 2014. Writer and producer for FX, HBO and Warner Brothers. Of counsel to Kirkland & Ellis. Former chief of staff to Lt. Governor Cruz Bustamante, counsel for the law firm of O'Melveny & Myers, federal prosecutor for the U.S. Department of Justice Criminal Division in Washington, D.C., and the Central District of California.

Sumi Sousa *(D-San Francisco)* Appointed to the Commission by Speaker of the Assembly John Pérez in April 2013. Officer of policy development for San Francisco Health Plan. Former advisor to Speaker Pérez. Former executive director of the California Health Facilities Financing Authority.

Full biographies available on the Commission's website at www.lhc.ca.gov.

"Democracy itself is a process of change, and satisfaction and complacency are enemies of good government."

Governor Edmund G. "Pat" Brown,
addressing the inaugural meeting of the Little Hoover Commission,
April 24, 1962, Sacramento, California