

Sierra Climate Change Toolkit

*Planning ahead to protect Sierra
natural resources and rural communities*

3rd edition



SIERRA NEVADA ALLIANCE

Keeping light in the range.

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Cover Photo: "Sierra Nevada," ©ElizabethCarmel.com

Sierra Nevada Alliance

The Sierra Nevada Alliance, a non-profit organization, has been protecting and restoring Sierra lands, water, wildlife, and communities since 1993. The Alliance has over seventy-five member groups and works to build the capacity of individuals and groups while uniting efforts to protect the entire region.

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Chapter 1: Introduction

Scientists agree that California and the Sierra are changing as greenhouse gas emissions cause global temperatures to rise. The Sierra snowpack is predicted to decrease by as much as 45% by mid-century and in worse case scenarios 90% by the end of the century. Wildlife has been observed moving upward and northward in the Sierra. Increasing temperatures will affect public health by increasing air pollution, possibly causing higher rates of mortality, and allowing the spread of vector-borne diseases like Lyme disease. Actions must be taken to reduce greenhouse gas emissions to prevent catastrophic warming and to adapt the changes already underway both in the Sierra and the state. Inaction could have significant repercussions, as the Sierra is a vital region to the state; the Sierra snowpack is the largest surface reservoir in California, the region is home to half the wildlife of the state, and is loved dearly for its outstanding recreation and unique rural communities.

Our unique Sierra landscapes and rural communities are already jeopardized by pollution, environmental degradation, and overuse. Now our natural systems and communities face a new and serious challenge: global climate change. Global warming threatens to push our already failing systems to the breaking point. But climate change is an emergency for which we can plan. We can work to prevent the worse-case scenarios and prepare for those we cannot avoid. There are easy and cost-effective strategies, tools, and resources that can help. We cannot afford the wasteful actions of the past and need to take responsible and innovative steps today to prepare for a new future. The next generation is relying on us; addressing climate change now is our responsibility.



“Tuolumne Meadows Sunrise” © ElizabethCarmel.com

The iconic landscapes of the Sierra face many challenges, including climate change.

The Sierra Nevada Alliance - Keeping Light in the Range



SIERRA NEVADA ALLIANCE

Keeping light in the range.

Founded in 1993, the Sierra Nevada Alliance unites hundreds of individuals and conservation groups to protect Sierra lands, water, wildlife, and rural communities. The Alliance supports our network of over 75 member groups while also working on regional issues through our programs and campaigns. We are driven by a vision of a Sierra where natural and human communities coexist in harmony and where residents and visitors alike understand and value the unique qualities of the range and protect the places they love. The following two programs at the Sierra Nevada Alliance address climate change and sustainability issues.

Regional Climate Change Program

The Sierra Nevada Alliance's Regional Climate Program engages and supports efforts to adopt exemplary and sustainable regional plans across the Sierra. These model resource plans incorporate climate change adaptation principles and are consistent with or exceed greenhouse gas emission reduction targets identified in state or national legislation. The program promotes win-win solutions that reduce greenhouse gas emissions, adapt to climate change, and protect ecosystem health, water quality, and water supply reliability. Finally, the Alliance prioritizes work on model plans that can be implemented and replicated across the Sierra region, including Integrated Regional Water Management Plans (IRWMPs), County General Plans, climate action plans, and forest plans.

Sustainable Sierra Communities Program

The Sierra Nevada is known for its rich rural character, but now more than ever, we face challenges that threaten our natural landscapes, resources, and way of life. To meet current challenges, the Alliance is forging new ground in the Sierra by encouraging sustainable communities.

The goal of the Sustainable Sierra Communities program is to foster and support local actions and planning that combat these threats and establish building blocks for more resilient, thriving Sierra communities. Through on-the-ground projects, model programs, publications, workshops, and events, we empower local action for a sustainable future.

To find out more information on the Sustainable Sierra Communities Program including current projects and publications:

- Sign up for the Sierra Nevada Alliance's monthly Climate Change electronic newsletter by emailing info@sierranevadaalliance.org with Subject: Subscribe Climate E-News. Include your name, affiliation (optional), phone number and email address.
- Check out our website: www.sierranevadaalliance.org.

For more information on the Sierra Nevada Alliance and our other programs, as well as a list of our member groups, visit:

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How to Use This Toolkit

This toolkit is meant to be a starting point for resource managers, local governments, community planners, non-profits, local activists, and concerned citizens to comprehensively address climate change across the Sierra by both reducing greenhouse gas (GHG) emissions and adapting to the impacts of climate change. This toolkit provides the latest science and resources regarding climate change impacts in the Sierra. It presents the regulatory context regarding climate change, including the most recent regulations, policy directions, and incentives to reduce emissions and adapt. Finally, it identifies frameworks, specific strategies, and case studies to help diverse stakeholders incorporate emission reduction and adaptation into Sierra plans and projects.

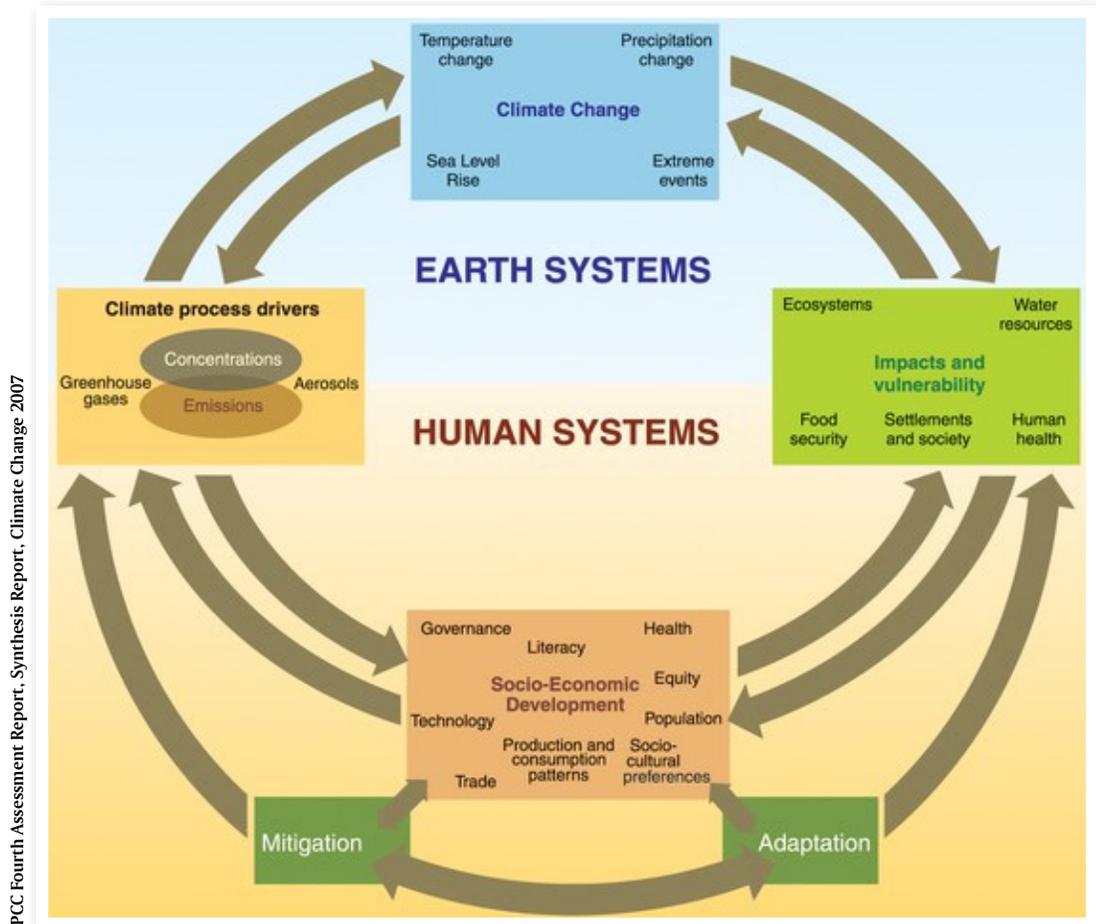
Climate Change is One of the Greatest Challenges and Opportunities Facing the Sierra

The Sierra Nevada Alliance's mission is to protect and restore the natural environment of the Sierra Nevada for future generations while ensuring healthy and sustainable communities. The Alliance believes climate change is the greatest challenge the Sierra faces in protecting the diversity and beauty of our natural environment as well as our vibrant rural economies. In addition to climate change, the Sierra faces myriad stresses to its human and natural communities including air pollution, impacts from sprawling development, recreational use, increasing use of water, and invasive species. The challenge of climate change presents the Sierra with an opportunity to both reduce these existing stresses and to make our communities and local economies more sustainable and our natural resources more resilient. The Sierra Climate Change Toolkit has been designed to help community leaders throughout the region understand the basic science of climate change, how climate change affects the Sierra, and how we can work together to reduce our regional carbon footprint and plan ahead to adapt and protect natural resources in the face of significant change.

Planning for Climate Change Now is Easier and Cheaper

Currently, many resource planning processes are occurring throughout the Sierra that will determine how our natural resources are managed and how our communities will grow over the next 5, 10, and/or 20 years, or more. Unfortunately, planning for climate change is not happening at the scale and pace necessary to address this challenge. Planning how to reduce emissions and adapt to climate change now will be easier and cheaper than waiting for a crisis and will allow us to come up with win-win solutions that protect our natural resources and our local economies. We can take advantage of existing planning processes and incentives to incorporate climate change emission reduction and adaptation strategies in ways that save money in the long run, enhance our local economies, and preserve our unique communities and ecosystems for the long term. Furthermore, the Sierra has the opportunity to take on this challenge and become a leading rural model for comprehensively addressing climate change.

This third edition of the Sierra Climate Change Toolkit, however, presents opportunities, strategic approaches, and actions to achieve adaptation and greenhouse gas emission reduction goals in the Sierra.



IPCC Fourth Assessment Report, Synthesis Report, Climate Change 2007

This diagram from the Intergovernmental Panel on Climate Change (IPCC) illustrates the complex relationships between human society and earth systems as well as the importance of emission reduction (mitigation) and adaptation activities to both reduce anthropogenic inputs and ameliorate the resulting impacts of climate change.

This Toolkit Focuses on Reducing Greenhouse Gas Emissions and Adapting to the Impacts of Climate

Over the past five years, the Sierra Nevada Alliance has been calling for a comprehensive response to climate change that includes:

1. Reducing GHG emissions to prevent potentially catastrophic climate changes and to transition to more sustainable, self-reliant Sierra communities.
2. Adapting to the impacts of climate change. Even under the best emissions-reduction scenarios, very significant changes in climate are predicted. Adapting to such change is critical.

If we don't act quickly to reduce GHG emissions and adapt now, we lose our opportunity to shape the future and prevent the worst impacts of climate change. Similarly, by only focusing on reducing GHG emissions, we may be equally unprepared for the climate change impacts already set in motion (see *Chapter 2: Climate Change Impacts* for more information) by more than 100 years of industrial development. It is clear that not only do we need to reduce emissions and adapt, but we need to address both in a thoughtful and coordinated manner. Past editions of this toolkit focused on how to address adaptation, as few resources and tools existed to help Sierrans address the current and predicted impacts of climate change. This

third edition of the Sierra Climate Change Toolkit, however, presents opportunities, strategic approaches, and actions to achieve adaptation and greenhouse gas emission reduction goals in the Sierra.

Momentum, Motivation, and Money to Address Climate Change Emission Reduction and Adaptation

In the last decade, and especially in the two and a half years since the previous edition of this toolkit was published, some responsible governments, nonprofits, and other organizations have started including climate change considerations in all levels of planning, regulation, and legislation. California's legislature has passed major land use and climate bills, and the federal government is beginning to tackle climate change in existing regulatory processes. Many existing planning and regulatory frameworks for local projects and regional planning processes include requirements or incentives for the decision-makers to address climate change. Funding is often available to incorporate climate change into many of these planning processes. The momentum to comprehensively address climate is growing and more action is expected in the coming years. This edition of the toolkit strives to provide up-to-date information on the mechanisms with which our state and nation are approaching climate change.

Whether you are involved in a long-term river restoration project, County General Plan update, dam relicensing, large-scale reforestation effort, or any other sort of resource-management or community-planning effort, this toolkit will enable you to include both greenhouse gas emission reduction and adaptation in your discussions and planning processes. Only by acting now to both reduce emissions and adapt will we be able to sustain our economies and protect the natural resources and communities upon which we depend and love.

The members of the greater Sierra community can be leaders in transforming the way rural areas deal with global climate change. While the State of California has implemented many forward-thinking measures and has funded critical research, the Sierra needs to take the lead in on-the-ground planning to ensure a healthy future for the Sierra's unique communities, ecosystems, and rural character in the face of global climate change.

We can leave the Sierra with a legacy of clean and adequate drinking water, healthy forests and woodlands, stable fish and wildlife populations, and vibrant local communities and economies for future generations. We hope this toolkit is a valuable resource to achieve this vision for everyone involved in planning and implementing projects in the Sierra Nevada.

This toolkit will review:

- The science of climate change and impacts on the global, national, state, and regional levels.
- The national, state, and regional context in which climate change emission reduction and adaptation efforts are occurring.

- Frameworks, specific strategies and case studies for reducing greenhouse gas emissions and adapting to climate change impacts through existing planning processes in the Sierra including:
 - ◆ Water and Watershed Management
 - ◆ Wildlife and Habitat Protection
 - ◆ Forestry Management
 - ◆ Wildfire
 - ◆ City & County Land-Use Planning
- Tools to help communicate climate change and build support for local action.
- Further resources to help your specific planning process or project address climate change comprehensively.
- Beyond this toolkit, you can also track new developments, find out about potential funding opportunities, and get useful tools by:
 - ◆ Signing up for the Sierra Nevada Alliance’s monthly Climate Change electronic newsletter by emailing info@sierranevadaalliance.org with Subject: Subscribe Climate E-News. Include your name, affiliation (optional), phone number and email address.
 - ◆ Checking out our website: www.sierranevadaalliance.org.

Chapter 2: Climate Change Impacts

For most of us in California, the temperate and somewhat predictable seasonal climate is a major attraction. It is also the engine that dictates our water supply, food production, energy demands, ecosystem health, recreation patterns, and much more. We are all accustomed to the climate's tremendous variability from year to year, but over the long term we often expect California's climate to behave as it has in the past. However, signs indicate that climate change is already occurring and impacting our state's ecosystems, cultures, and economy. As a result, we are going to have to change the way we view our climate and how we manage our natural resources.

Data increasingly confirms that climate change is underway now. Caused by a variety of factors like fossil fuel emissions, deforestation, and other human activities, climate change already presents a dilemma for humankind. Synthesis reports which compile the latest scientific knowledge on the issue from various national governments and the Intergovernmental Panel on Climate Change increasingly describe more rapid and severe changes and contain evidence suggesting humans are the primary driver of climate change. Today, the scientific questions on climate change focus on how much change to expect, what human and natural systems will be most severely impacted, and what the most appropriate and beneficial responses are. As a result, those managing our natural resources and communities must reduce emissions and prepare for a range of future scenarios.

In the Sierra, we are already experiencing climatic changes. In the May 2009 Special Climate Report for the California Energy Commission¹, documented observations included:

- Minimum temperatures are increasing in the summer. Heat waves are largely due to unprecedented night-time temperatures with maximum day-time temperatures increasing at slower rates.
- More precipitation is falling as rain rather than snow. The trend is toward less total snow accumulation with less water content in the snow as of April 1, the date when water managers determine how much water will be available to the State for the summer and fall.

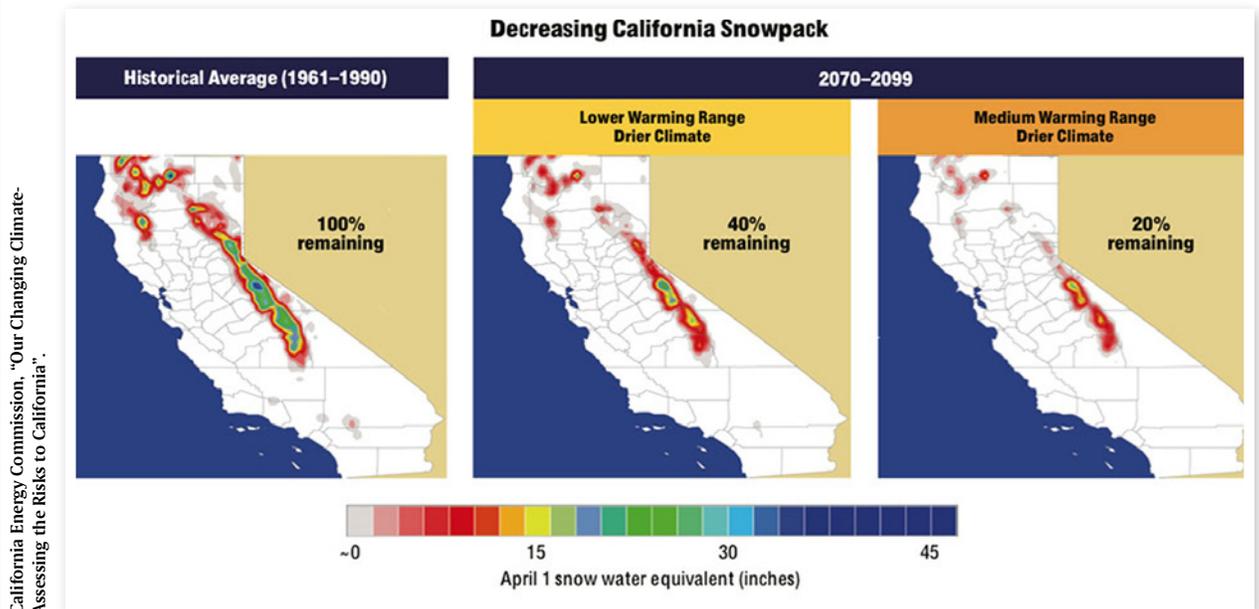
Models (a recreation of a natural system or object that attempts to recreate the key components and interactions of the physical system) show that we can expect significant changes in ecosystems as a result of the expected increase in overall temperature coupled with already compromised ecosystems in the Sierra. Our ecosystems have been affected by fragmentation and from less frequent fire intervals resulting in larger bark beetle infestations. These ecosystems have also been affected by invasive species, over-grazing, and pollution. All of these conditions exacerbate the potential impacts of climate change.

California will see substantial impacts. For example, the predicted higher temperatures will reduce the snowpack in the Sierra Nevada with serious implications for winter recreation, wildlife, and statewide water supplies. The Sierra snowpack is California's largest surface

reservoir. California's (and to an extent Nevada's) massive water delivery system is extremely dependent on the Sierra snowpack, which stores water over the winter and early spring, then melts over the spring and early summer to refill water reservoirs that supply water in the late summer and fall. When more precipitation falls in the form of rain during the winter, the state's dams and reservoirs often let more water through the system to prevent flooding in the winter and early spring. This presents a challenge for water managers. As precipitation patterns and timing change, it is more difficult to predict when to let the water through the system for flood protection, and when to store the water for use in the summer and fall when it is needed.

There are two major courses of action we must all take to ensure a future that retains many of the qualities that we enjoy today. We must reduce greenhouse gas (GHG) emissions to prevent extreme climate changes. At the same time, we must adapt to the changes that we cannot prevent and adapt in ways that protect our communities and our natural environment and biodiversity. The financial and environmental impacts of climate change are going to be far more severe the longer we delay reducing emissions and taking adaptive action. By planning now and by incorporating information about climate change into decisions about how we manage our environment and our communities, we can reduce the negative impacts of human-caused climate change and natural climate variability.

This section starts with climate change impacts at the global level in order to provide a sense of the major changes that are likely to occur and how the local Sierra impacts fit into the broader picture. It then progresses into impacts in North America and the United States, before focusing on impacts specific to California, Nevada, and the Sierra.



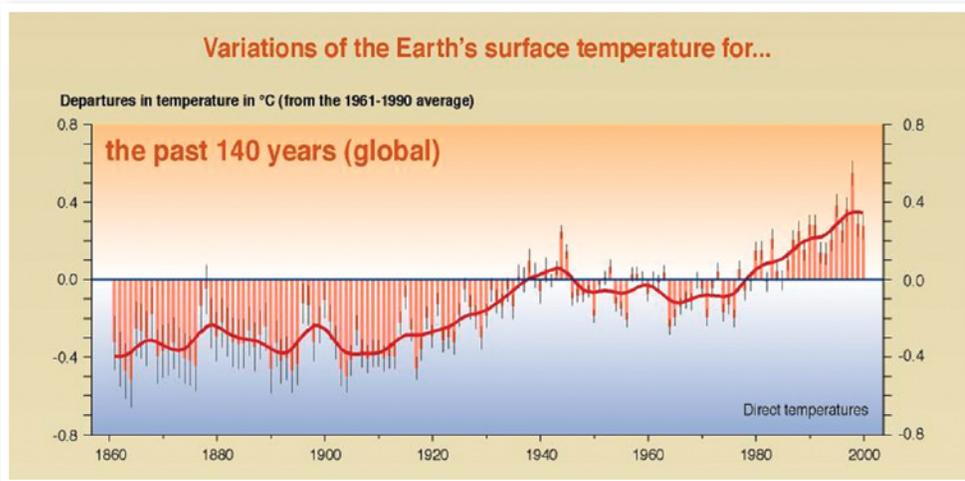
By the end of the century, spring snowpack in California is projected to decline by 60% to 80%.

Climate Change at the Global Level

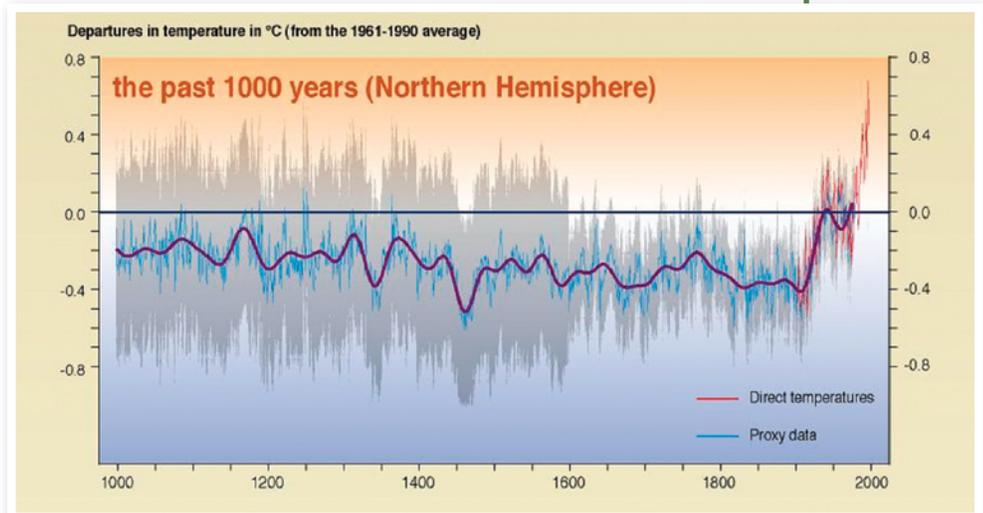
Rising Temperatures

- Over the past 30 years the rate of global warming has increased at a rate approximately three times faster than the trend over the entire past century. The rate of global warming has accelerated over the past 30 years, increasing since the mid-1970s at a rate approximately three times faster than the trend as seen over the entire past century.²
- 2000 – 2009 was the hottest decade on record (since 1850), with the average global surface temperature about 0.96° F (0.53° C) above the 20th century average.³ The previous decade from 1990 to 1999 was the previous hottest decade on record.
- Over the last 50 years, cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent.⁴
- On average, between 1950 and 1993, nighttime air temperatures increased at about twice the rate (0.4° F) of daytime temperatures.⁵

Recent research estimates that the global average sea level will rise between 1.9 and 4.6 feet (0.6 to 1.4 meters) in the next century.



IPCC Fourth Assessment Report, Working Group I Summary for Policymakers, Climate Change 2007.



These graphs depict variations of the Earth's surface temperature for the past 140 years and the past 1000 years based on the average temperature between 1961 and 1990. On both these scales, temperatures have risen noticeably globally and in the Northern Hemisphere over the past 100 years.

Increasingly Severe Weather

- The intensity of tropical cyclones (hurricanes) in the North Atlantic has increased over the past 30 years, which correlates with increases in tropical sea surface temperatures.⁶
- Storms with heavy precipitation have increased in frequency over most land areas. Between 1900 and 2005, long-term trends show significantly increased precipitation in eastern parts of North and South America, northern Europe, and northern and central Asia.⁷
- It is projected that by the year 2020, between 75 and 250 million people in Africa could be exposed to increased water stress due to climate change, which severely compromises food security and exacerbates malnutrition.⁸
- The 2003 heat wave was the hottest weather Europe had experienced in at least 500 years and claimed the lives of 52,000 people.⁹

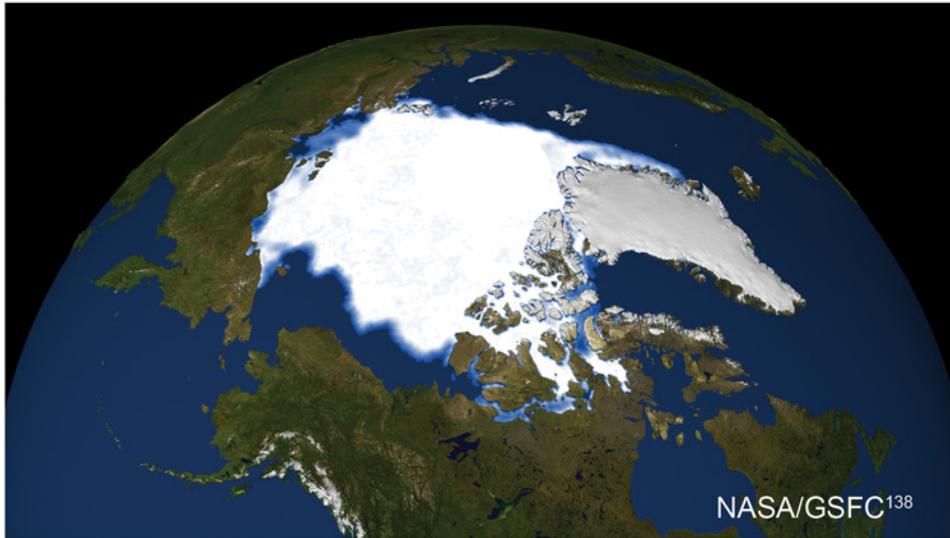
Melting Snow and Ice

- Since 1900 the Northern Hemisphere has lost 7% of the maximum area covered by seasonally frozen ground.¹⁰
- Satellite data since 1978 shows that the extent of Arctic sea ice during the summer has shrunk by more than 20%. Models predict that by the second half of the 21st century, Arctic late summer sea ice could disappear almost entirely.¹¹
- The Arctic contains nearly one-third of the Earth's carbon stored in soil, which is expected to be released into the atmosphere if the soil continues to warm, further exacerbating the problem.¹²
- There has been a reduction of about two weeks in the annual duration of lake and river ice cover in the middle to high latitudes of the Northern Hemisphere in the last 100 years.¹³

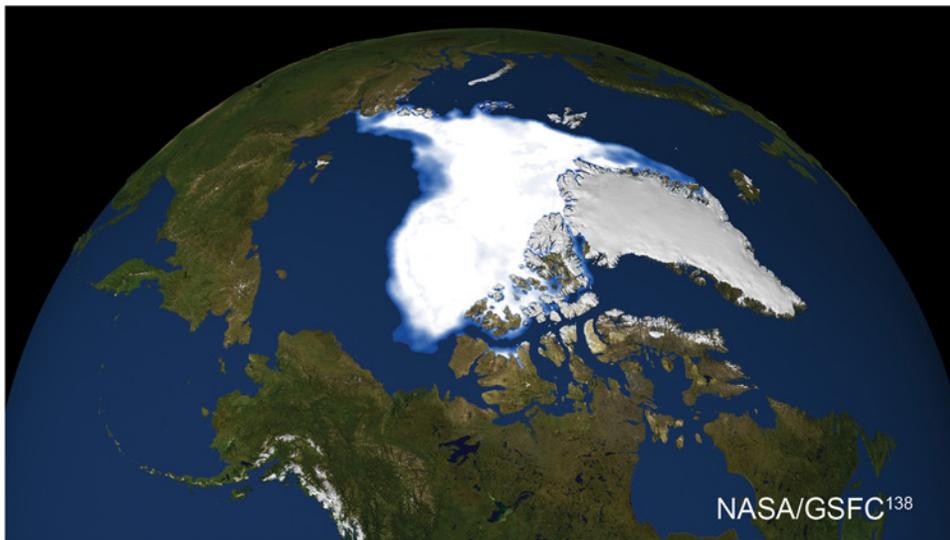
Rising Sea Levels

- Since 1961, the world's oceans have been absorbing more than 80% of the heat added to the climate, causing ocean water to expand and contributing to rising sea levels. Between 1993 and 2003 ocean expansion was the largest contributor to sea level rise.¹⁴
- Thermal expansion and glacial melt have already raised the oceans four to eight inches (10.16 to 20.32 centimeters).¹⁵
- Recent research estimates that the global average sea level will rise between 1.9 and 4.6 feet (0.6 to 1.4 meters) in the next century.¹⁶
- The International Panel on Climate Change (IPCC) predicts that the global average sea level will rise between 0.6 and 2 feet (0.18 to 0.59 meters) in the next century.¹⁷
- The IPCC suggests that by 2080, sea level rise could convert as much as 33% of the world's coastal wetlands to open water.¹⁸

1979



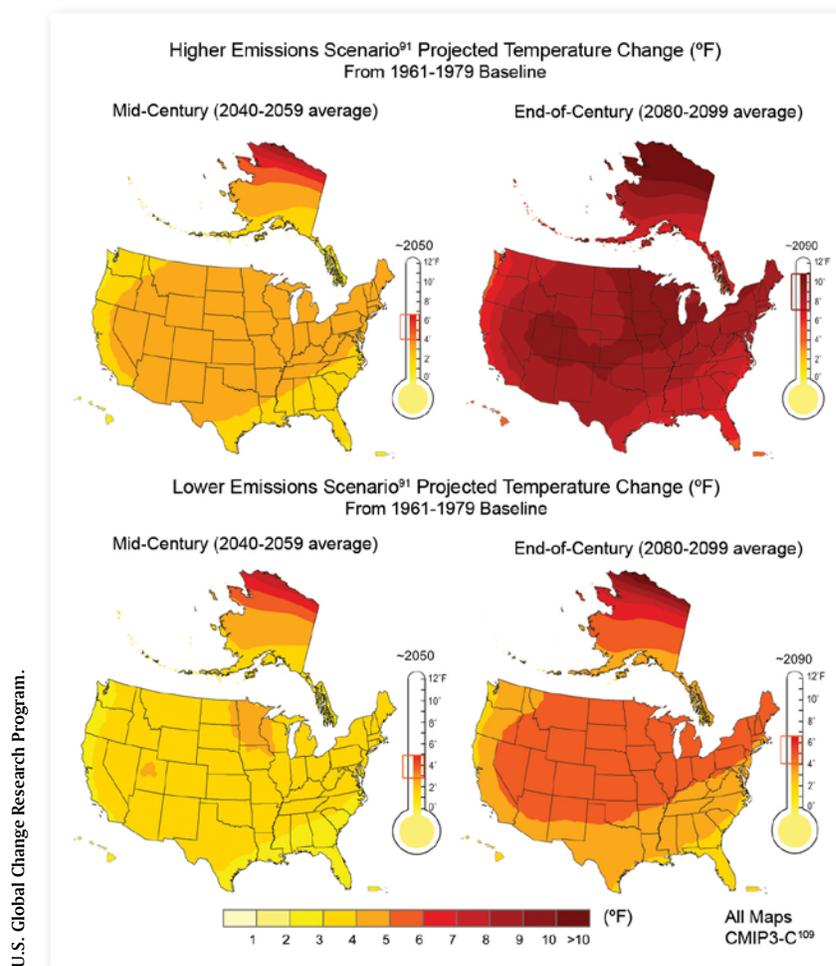
2007



The annual minimum extent of arctic sea ice has been decreasing over the past 30 years, as seen here in satellite imagery from 1979 and 2007.

Moving Wildlife

- Estimates suggest that about 10% of species will be condemned to extinction for each 1.8° F (1° C) temperature rise due to inability to adapt or migrate quickly enough.¹⁹
- Recent estimates indicate that 25% (~1,125 species) of the world's mammals and 12% (~1,150 species) of birds are at a significant risk of global extinction.^{20,21}
- Data collected on the effects of climate change on more than 1,500 plant and animal species around the globe show that half of those species have clearly shifted upward or northward in recent decades.²²
- Two-thirds of those species are breeding earlier in the year. Only a handful are moving to warmer climates, or breeding later.²³
- Climate change impacts on inland aquatic ecosystems will be caused by the direct effects of rising temperatures and rising carbon dioxide (CO₂) concentrations and the indirect effects caused by changes in regional or global precipitation and the melting of glaciers and ice cover.²⁴



These maps depict projected future temperature changes for the United States under two emissions scenarios. Under the higher emissions scenario (i.e. little action is taken to reduce GHG emissions), nearly the entire United States could see temperature increases of 7-10°F by the end of the century. Under the lower emissions scenario (i.e. significant action is taken to reduce GHG emissions), the regions of the United States could see anywhere from a 4 to 10°F rise in temperatures.

Climate Change at the National & North American Levels

Rising Temperatures

- The average temperature in the United States has risen more than 2° F (1.1° C) over the past 50 years.²⁵
- On average, spring now arrives in the United States 10 to 14 days earlier than it did 20 years ago.²⁶
- In Alaska's Boreal Forests, minimum spring temperatures have risen by 8° F (4.4° C) over the last 80 years, and the growing season has lengthened by 20 days.²⁷

Melting Snow and Ice

- When Glacier National Park was established in 1910, it contained 150 glaciers. As of 2010, only 25 glaciers remain at about one-third their original size.²⁸ Even if no further climate forcing occurs, the remaining glaciers are predicted to be gone by 2100.²⁹
- Weather systems have caused winter storms to shift northward over the past 50 years with higher intensity and frequency.³⁰
- The Arctic freeze-free (growing) season has grown by 12 days since the 1970s.³¹
- Alaska's famed 1,100 mile race, the Iditarod, has moved 40 miles north due to lack of snow. The last time the race started in Wasilla was in 2002.³²
- Newtok is a Native Alaskan village that is being forced to relocate as a river and the ocean erode its shorelines. The erosion rates have been exacerbated by thawing permafrost, declining sea ice protection, increased storm surge exposure, and warming temperatures. This makes the Newtok the first "climate refugees" in the United States.³³



Matt Griffith

All glaciers in Glacier National Park, Montana are predicted to disappear by 2100.

Rising Sea Levels

- Sea level has been rising from between 0.08 to 0.12 inches per year (2.0-3.0 mm per year) along most of the U.S. Atlantic and Gulf coasts.³⁴

Moving Wildlife

- The red fox of northern Canada moved its range 600 miles northward in just 30 years.³⁵
- Five species of tropical butterflies have recently been recorded in Texas, with some individuals trying to breed as far north as Austin, about 700 miles north of their historic range.³⁶
- Northeastern bird species that migrate long distances and winter in the southern United States arrive back in the Northeast an average of 13 days earlier than they did during the first-half of the last century.³⁷
- In 2005, the Caribbean basin experienced unprecedented water temperatures that resulted in dramatic coral bleaching with some sites in the US. Virgin Islands seeing 90% of its coral bleached.³⁸

Union of Concerned Scientists, Climate Choices (http://www.climatechoices.org/impacts_overview/).

	Statewide Average Annual Temperature Rise	Sierra Snowpack	sea level	urban heat wave days	conducive to ozone formation	critical dry years	urban heat related deaths	electricity demand	pine forest yields	risk of large wildfires	Emissions Scenarios
10.5 °F Higher Warming Range	90% loss	22-30 inch rise	3-4 times as many	— not modeled	3 times more	4-6 times as many	20% more	— not modeled	— not modeled	— not modeled	Higher Emissions Fossil-fuel intensive growth
8.0 °F Medium Warming Range	70-80% loss	14-22 inch rise	3-4 times as many	75-85% more days	2-3 times more	2-6 times as many	10% more	30% loss	55% more		Medium-High Emissions Fossil-fuel intensive growth with some improvements in energy efficiency
5.5 °F Lower Warming Range	30-60% loss	6-14 inch rise	2-3 times as many	25-35% more days	2 times more	2-3 times as many	3-6% more	7-14% loss	10-35% more		Lower Emissions Less fossil fuels, more clean technology
3.0 °F											

A summary of predicted global warming impacts in California for 2070-2099 under 3 emissions scenarios as compared to 1961-1990.

Climate Change at the California, Nevada, and Sierra Nevada Levels

Rising Temperatures

- Under the business-as-usual scenario for emission reduction, temperatures are expected to rise between 2.7° F (1.5° C) and 10.5° F (5.8° C) in California by 2100.³⁹
- An air temperature increase of 1.8° F (1° C) is expected to reduce the average annual snowmelt in California by about 15%, and an increase of 7.2° F (4° C) is expected to reduce the annual snowmelt by 60%.⁴⁰
- Runoff would also shift earlier into the year, which is when many reservoirs are operated for flood protection and release waters, not for capturing water supply. A 7.2° F (4° C) increase in air temperature shifts the mean runoff from mid-March to mid-February.⁴¹

Increasingly Severe Weather

- The heat wave season—the period during which temperatures reach 90° F (32° C) or higher for three or more consecutive days—has lengthened to between 132 and 204 days a year in California. Historically, the heat-wave season has lasted only 115 days.⁴²
- From 1987 to 2003 the western United States has seen a fourfold increase in wildfires over the preceding 16 years, and burned 6.5 times more land. The average fire duration increased from 7.8 to 37 days, while the average fire season grew by an average of 78 days.⁴³ Though the Sierra is experiencing a fire deficit due to a century of fire suppression, the study was able to link climate change to some of the increased fire.

On average, spring now arrives in the United States 10 to 14 days earlier than it did 20 years ago.

Melting Snow and Ice

- Earlier snowpack melting in the Sierra Nevada has resulted in some year-round mountain streams going dry by summer and creating 12% less spring and summer snowmelt in the Sacramento River than 100 years ago.⁴⁴
- The fraction of annual runoff from the central Sierra that occurs in late spring has been decreasing for approximately the past 50 years. More of the annual runoff has occurred in the winter.⁴⁵
- By mid-century, spring snowpack in the Sierra Nevada is projected to decline about 25% to 40%. Toward the end of the century, losses could reach 30% to 90%.⁴⁶
- Black and brown soot is adding to the rapid melting of arctic sea ice, as well as the Sierra Nevada snow pack. When black carbon emissions land on snow and ice it changes the reflectivity of the snow and ice, causing it to warm quickly and melt earlier.⁴⁷
- By 2050, a combination of delayed snow accumulation and earlier snowmelt could shorten the Sierra Nevada ski season by three to six weeks. By the end of the century, the ski season could be shortened by 7 to 15 weeks.⁴⁸
- In most cases, total annual streamflow into major Sierra Nevada reservoirs is projected to drop about 10% to 20% before mid-century and 25% to 30% before the end of the century.⁴⁹

- As the runoff season begins earlier, spring and summer streamflow is projected to decline about 10% to 20% before 2050. By the end of the century, spring and summer streamflow could be reduced by as much as 40%.⁵⁰
- In the Sierra Nevada, seven of the largest glaciers (Dana, Lyell, Kneiss, Maclure, Mendel, Darwin, and Goddard) have retreated 30% to 70% in the past 100 years.⁵¹
- By the end of the century, if greenhouse gas emissions continue unabated, statewide annual average temperatures are expected to rise into the higher warming range (8° F to 10.5° F), decreasing the spring snowpack in the Sierra by as much as 90%.⁵²

Moving and Disappearing Wildlife

- Pika, adapted to cold climates, historically lived at about 5,700 feet above sea level but now averages higher than 8,000 feet. The extinction of several subpopulations is highly correlated to climate change and their inability to adapt to warmer temperatures.⁵³
- Two-thirds of the more than 5,500 native plant species in California are expected to reduce their range by as much as 80% by the end of the century.⁵⁴
- One study of the Edith's checkerspot butterfly found that 40% of the populations below 2,400 feet have gone extinct, while new populations have been found further north than previously recorded.⁵⁵
- Forty-eight out of 53 bird species studied in the Sierra Nevada have adjusted to climate change over the last century by moving to sites with the temperature and precipitation conditions they favored.⁵⁶



Marion Gee

The American pika, found across the higher elevations of the Sierra, is now at the center of a scientific and political debate as to whether it is at risk of being extirpated from the Sierra as a result of climate change.

- The Sierra Nevada yellow-legged frog was common in Sierra Nevada high-elevation lakes and slow-moving streams at elevations ranging from 4,500 to 12,000 feet. But its range has decreased more than 80% in the last 90 years due to a number of factors such as fish stocking and chytrid fungus. These frogs need two to four years of permanent water to complete their development, so repeated tadpole mortality from lakes drying up in summer leads to population decline. This could become more common in a warmer, drier climate.⁵⁷
- Research demonstrates that young bristlecone and limber pines in the White Mountains of the Inyo National Forest have been moving up in elevation and into newly opened cooler microclimate niches in steep-sided valleys and ravines.⁵⁸
- A decades-long study has found that smaller conifer trees in old growth forests in Sequoia and Yosemite National Parks are dying at nearly double the rate as they were two decades ago, stressed by hotter temperatures and lower precipitation. The study, begun in 1983, examined 21,338 trees in a variety of forests and found the average mortality rate increased every year by about 3%, leading to a near doubling of the rate by the end of the period. The death rates, however, did not apply to larger trees, which can better survive moderate droughts.⁵⁹
- All life stages of the Paiute cutthroat trout require cool, well-oxygenated waters. As cold-water habitats warm, rising temperatures caused by climate change will have negative impacts on all life phases of these fish, from eggs to juveniles to adults.⁶⁰

These impacts are only a subset of the substantial body of information on climate change and the projections for future changes. While these impacts, both current and predicted, can be at times overwhelming, there is considerable momentum, motivation, and money to both reduce our greenhouse gas emissions and prepare for the changes we can't prevent. The next four chapters highlight new strategies, opportunities, and case studies to take action on emission reduction and adaptation. The information, resources, and tools will help our Sierra community rethink, innovate, and prepare for this new future while also sustaining our local economies, improving our communities' health and vitality, and restoring our unique ecosystems.

By mid-century, spring snowpack in the Sierra Nevada is projected to decline about 25% to 40%. Toward the end of the century, losses could reach 30% to 90%.

Chapter 3: Reducing Greenhouse Gas Emissions in the Sierra

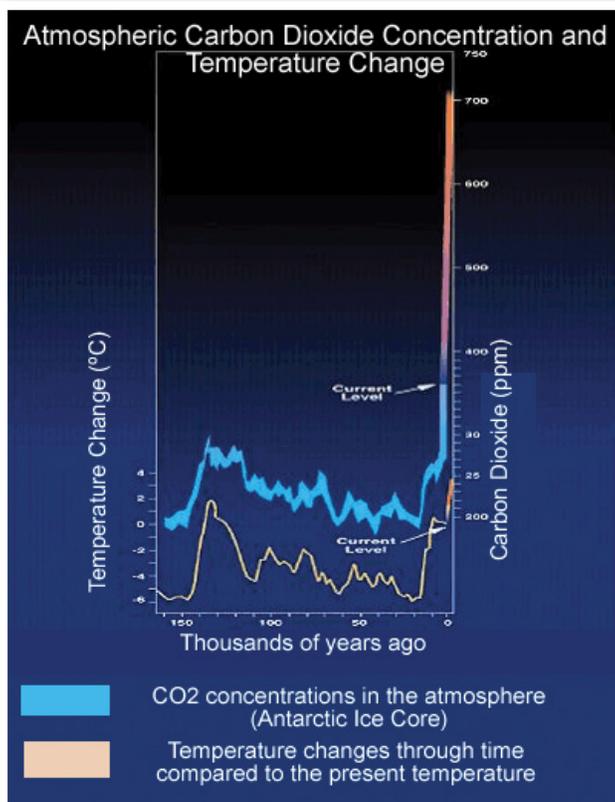
The debate amongst climatologists about the causes of global warming and whether human-emitted greenhouse gases are a major factor is well behind us. In light of the evidence and the magnitude of potential change to our ecosystems and communities, we owe it to ourselves and future generations to make changes now to substantially reduce greenhouse gas emissions. The United States remains the leading per capita emitter of greenhouse gases. Nationally, we have no plan to significantly reduce our emissions of greenhouse gases, though some regulations exist for federal agencies. Within California, we have legislation to reduce emissions, but it has yet to take full effect. In the meantime, Sierra planners, administrators, and agencies can take important steps to reduce emissions related to land use, water, energy, forestry, and other sectors – saving money and building more resilient communities in the process.

Despite some small steps by governments locally, nationally, and internationally, the climate change situation remains extremely serious. Even if we manage to reach stable carbon dioxide and other greenhouse gas (GHG) levels at 450 parts per million, atmospheric temperatures

will still rise by approximately two degrees. Furthermore, the world's governments have yet to pledge or take action that indicates that we can stabilize at this relatively low concentration of carbon dioxide. Every day that we fail to act on reducing our emissions further traps us into a future with changed resource availability and warmer, more unstable climates.

The first step in cutting GHG emissions is to understand where they come from. A later portion of this chapter goes over conducting your own greenhouse gas inventory, but it is important to know generally where emissions come from in California and the Sierra. The most recent inventory of emissions conducted by the California Air Resources Board (ARB) determined that 40% of the state's GHG emissions come from transportation, which is largely a result of the historically poor land use policies in use throughout the state. Due to the Sierra's rural nature, Sierra residents drive disproportionately more, and stand to gain large savings and

The White House, "Atmospheric Carbon Dioxide Concentration and Temperature Change," 2002



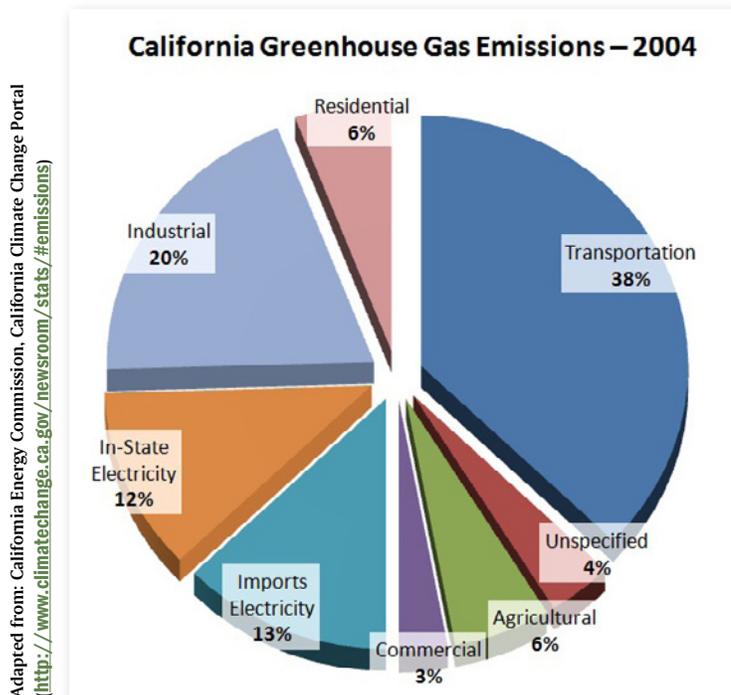
This graph illustrates the relationship between atmospheric carbon dioxide concentration and temperature change over the past 160,000 years. Current levels of carbon dioxide are at their highest concentrations and global temperatures are predicted to rise dramatically as carbon dioxide concentration increases in the future.

The most recent inventory of emissions conducted by the California Air Resources Board (ARB) determined that 40% of the state's GHG emissions come from transportation.

community benefits from land use planning strategies that reduce emissions. Other major sources of emissions statewide include electricity usage, and the transportation, heating, and treatment of water. Emissions from land use, transportation, and water systems require concerted long-term efforts to reduce since they are based on how we choose to grow over time and where we place our infrastructure.

In 2006, California became the first state in the nation to regulate carbon with the passage of the Global Warming Solutions Act (AB 32), which mandates a reduction of emissions to 1990 levels by 2020. More recently, in 2008, the state passed Senate Bill 375 (SB 375), which requires regional land use and transportation planners to attempt to reduce the emissions related to personal transportation. These laws potentially have impacts beyond California by encouraging other states, the federal government, and other countries to act. Even so, these laws do not reduce emissions at the level recommended by the Intergovernmental Panel on Climate Change (IPCC) to avert the worst impacts of climate change.

These California laws are only now beginning to take effect due to the time required to develop the necessary rules, regulations, and infrastructure. As a result, the regulatory landscape is rapidly changing for carbon emissions across California. Non-profits, local governments, and businesses, however, need not wait for final regulations to implement best practices to achieve carbon reductions in their own work. Many of these best practices will likely be part of state or local regulations in the near future via AB 32 or SB 375. Additionally, the update of the California Environmental Quality Act (CEQA) guidelines under SB 97, discussed later in this chapter, provides an existing avenue to address climate change emissions. This chapter strives to give resource managers, local government and agencies, and other Sierrans working on climate change emissions reduction an overview of existing and expected regulation at the national and state levels. The latter half of the chapter includes recommendations and other opportunities to reduce emissions and save money.



Many sectors account for California's greenhouse gas emissions, with transportation being the largest contributor. Please note, numbers do not add to 100% due to rounding.

Federal Regulations and Laws

As a result of varying government acceptance of climate change science in the past, the current state of climate change regulation at the national level is mixed. Over the past couple years, various mandates have come from Congress, the White House, and federal agencies regarding climate change planning and emissions reduction, but comprehensive legislation addressing the problem has not yet been completed. As a result, current climate change regulations at the national level are limited in scope and often only directly affect federal agencies.

Requirements on Federal Agencies

In October 2009, President Obama issued an executive order requiring federal agencies to set emission reduction targets for their activities. In January 2010, President Obama announced in a subsequent executive order that federal agencies had committed to reduce emissions by 28% from 2008 levels by 2020. Agencies have some flexibility in implementing these targets, since they each have the individual reduction targets they initially set.⁶¹

In February 2010, the Council on Environmental Quality (CEQ) released a proposal to modernize environmental reviews under the National Environmental Policy Act (NEPA). See the informational box on page 32 for an explanation of NEPA. The first change made by the draft NEPA guidelines would include carbon emissions reporting in NEPA reviews for federal agencies. The guidelines use the same threshold for reporting [from stationary sources] as the federal Clean Air Act. This annual threshold, equivalent to 25,000 tons of carbon dioxide (CO₂), is used in the draft guidelines in order to maintain consistency. But the guidelines also specify that emissions from any sources that the agency conducting the review finds “meaningful” must be included in the environmental review as well.⁶² Additionally, the proposal recommends that the review quantify cumulative lifetime emissions for the project and recommend emissions reduction strategies including project alternatives. Currently, the draft guidance applies primarily to projects as defined by NEPA, and CEQ is still drafting guidelines for GHG consideration in non-project land and resource management actions.

Federal Legislation

Currently, no national emissions standards or renewable energy mandates exist in the United States. However, numerous states, including California, have laws directly regulating greenhouse gas emissions (GHGs), and 30 states have Renewable Portfolio Standards that specify the minimum amount of electricity that can be generated from renewable sources. In the 2009-2010 Congressional Session both houses of Congress considered numerous pieces of climate change legislation, but no comprehensive legislation was completed, passed, and signed.

The national politics on this issue are complicated, and direct congressional action on the issue remains unlikely. Regardless, there are a number of approaches that Congress has previously discussed that are important to understand when dealing with GHG emissions. Here are a few provisions to watch for:

1. **A Carbon Cap:** If the legislation is intended to explicitly address climate change, then many predict it will contain a limit on the nation’s carbon emissions that is reduced yearly, known as a declining carbon cap. This cap will likely cover a large portion, if not all, of the economy’s emitting sectors.

- ◆ Most proposals over the last decade have involved an approximately 2% linear decline in emissions annually.
- ◆ For the year 2020, the Intergovernmental Panel on Climate Change (IPCC) recommends that industrialized nations commit to reduce emissions 25 to 40% below 1990 levels. For reference, California's AB 32 requires a reduction to 1990 levels by 2020, and most congressional proposals have required lesser reductions.
- ◆ For the year 2050, most proposals require a reduction in emissions of approximately 80% from 1990 levels. The IPCC recommends industrialized nations make reductions of 90% from 1990 levels by 2050.⁶³

2. Emissions Permits:

- ◆ **Permit Sales:** Past federal legislative proposals required companies that emit carbon to purchase or receive licenses or permits from the government in order to emit. In most proposals, they could sell these permits at a market set price when they no longer need them. This structure is intended to spur reductions from those who can make them cheapest while providing time for other companies to make more expensive or difficult reductions.
- ◆ **Revenue from Permit Sale Programs:** The use of revenue generated from the sale of permits is subject to debate. Most proposals return a large portion of revenue to consumers or use revenue and other government funds to fund research and implementation of transition technologies and adaptation programs.

3. **Renewable Electricity Standards:** Past proposals included provisions mandating minimum percentages of renewable or clean energy, but the amount varied and what qualified as "renewable" and "clean" energy remains undecided. These proposals are similar to California's Renewable Portfolio Standard (discussed below).

Clean Air Act Requirements

While it remains uncertain when Congress will address climate change, the U.S. Environmental Protection Agency (EPA) is currently required to establish regulations for CO₂ under the Clean Air Act. A 2007 landmark Supreme Court case, *Massachusetts v. EPA*, determined that under the Clean Air Act, EPA must rule on CO₂'s impact on public health and, if impacts were found, regulate it appropriately. While the federal government mostly ignored this mandate for many years, EPA released a finding of endangerment in 2009 and began the process of regulating carbon. The finding of endangerment is a science-based determination that carbon emissions endanger the public's health and wellbeing and is the first step in regulating a new pollutant under the Clean Air Act. Barring legislation from Congress that prevents further action via Clean Air Act requirements, EPA will have its regulations ready by January 2011. Thus far, federal action is targeting major emitters of CO₂ that emit more than 25,000 tons of carbon dioxide annually.

Other Federal Programs

The federal government has stated that they are looking at other methods for regulating carbon as well. Some groups have attempted efforts to partially address climate change under the Endangered Species Act (ESA) by petitioning for the polar bear and the American Pika to be listed as endangered species due to climate change impacts on their populations. The listing of the American Pika was denied, though efforts to list it continue. The polar bear is

now listed as a threatened species because of climate change. However, federal actions were heavily restricted during its listing. Legal and administrative actions continue to utilize the ESA and climate change's impacts on endangered species. Additionally, some candidates for listing, such as the wolverine, now have climate change listed as the major impact on their population, so this avenue of regulation is important to watch.

In 2009, EPA joined with the Department of Housing and Urban Development (HUD) and Department of Transportation (DOT) to create a Sustainable Communities Partnership. While relatively new, this program aims to coordinate housing, transportation, and infrastructure in order to protect the environment, address climate change, and promote equitable development. In 2010, the program offered \$100 million dollars from HUD for Sustainable Communities Regional Planning Grants that support more livable and sustainable communities across the country. The program also offers other grants for community-scale environmental programs.

Further Resources

Common mechanisms in climate change legislation:

<http://www.rff.org/News/Features/Pages/climate-change-legislation-introduction.aspx>

Track legislation on OpenCongress:

http://www.opencongress.org/issues/show/5736_climate_change

Track legislation on The Library of Congress' Thomas:

<http://thomas.loc.gov>

California Level Regulations

California's Global Warming Solutions Act of 2006, often known by its bill designation as Assembly Bill 32 (AB 32), mandates GHG reduction targets for the state as a whole. While the Legislature and the governor set targets of 1990 emissions levels by 2020, it did not specify how these reductions should be achieved. Instead, the California Air Resources Board (ARB) was directed to determine where effective reductions could be made in California.

In December 2008, ARB approved its final scoping plan, which laid out avenues of achieving reductions under AB 32. The plan represents a multi-pronged approach to reductions that takes into account the practicality and economics of implementing each reduction. It includes reductions from electricity emissions, water deliveries, industrial sectors, vehicle fuels, landfill methane, and more.

As of the date of this publication, ARB has approved regulations that account for approximately half of California's 2020 reduction target, including all of the early action items they identified.⁶⁴ When complete, the program will include reductions from renewable electricity, land use regional targets (see later in this chapter), commercial recycling, a cap and trade program, and clean cars. As regulations progress, ARB is posting economic analyses online at <http://www.arb.ca.gov/cc/scopingplan/economics-sp/economics-sp.htm>. Those interested in getting involved with ARB's planning processes can subscribe to ARB email lists to be alerted of workshops at <http://www.arb.ca.gov/listserv/listserv.php>.

The scoping plan focuses on priority programs. The programs are now in the development stage and one should expect guidance and incentives to emerge on a program by program

basis based on ARB's Scoping Plan timeline (see further resources below). The bulk of AB 32's 169 million metric tons (MMT) of reductions will be made by these programs:

- **Cap and Trade Program** – Targeted reduction of 34.4 MMT annually by 2020. ARB is currently finalizing the cap and trade program, which places limits on carbon emissions statewide, with implementation to begin soon. In addition to the potential for adjustments to many sectors of California's economy, this program is important to watch because it could have significant impacts on Sierra forest lands. Sierrans should watchdog implementation of programs within the cap and trade system related to forestry to ensure that forests are not managed solely for sequestration ignoring the importance of maintaining ecological function.
For more information, see <http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm>.
- **Carbon Efficiency for Cars (Pavley regulations)** – Targeted reduction of 27.7 MMT by 2020. This regulation seeks to reduce the carbon intensity of driving, via improving automobile fuel efficiency. This program puts a limit on carbon emissions per mile on new cars sold in California, similar to fuel efficiency mile per gallon regulations.
For more information, see <http://www.arb.ca.gov/cc/ccms/ccms.htm>.
- **Energy Efficiency Measures** – Targeted reduction of 15.2 MMT by 2020. Ongoing deployment of ARB's existing energy efficiency measures and incentives.
For more information, see <http://www.cpuc.ca.gov/PUC/energy/Energy+Efficiency/>.
- **Renewable Electricity Standard** – Targeted reduction of 13.4 MMT by 2020 above previously existing requirements. Governor Schwarzenegger directed ARB to adopt regulations by July 31, 2010 mandating that the state's energy providers generate 33% of their energy from renewable sources by 2020. This regulation has been adopted by ARB.
For more information, see <http://www.arb.ca.gov/energy/res/res.htm>.
- **Low-Carbon Fuel Standard** – Targeted reduction of 16 MMT by 2020. Similar to how fuel efficiency standards reduce fuel used per mile driven, a low carbon fuels standard seeks to reduce carbon generated per unit of fuel used to further reduce carbon intensity per mile.
For more information, see <http://www.arb.ca.gov/fuels/lcfs/lcfs.htm>.
- **Stationary Equipment Refrigerant Management Program** – Targeted reduction of 8 MMT by 2020. This program aims to reduce leaks of high global warming potential (GWP) refrigerants from non-residential sources. Global warming potential is a measure of a chemical's impact on the climate when released into the atmosphere. Most refrigerants have high GWPs, signaling more impact.
For more information, see <http://www.arb.ca.gov/cc/reftrack/reftrack.htm>.
- **Green Building Standards** – Targeted reduction of 26 MMT. The green building standards are not included in the 2020 reductions target and are an ongoing effort to reduce emissions. Green building is a construction method that strives to achieve many environmental, health, and economic goals and includes improved energy and water efficiency designs that result in reductions of GHGs compared to past building standards.
For more information, see <http://www.energy.ca.gov/greenbuilding/>.

Renewable Portfolio Standards

Renewable Portfolio Standards (RPS), often known as Renewable Electricity Standards in other parts of the country, mandate that a percentage of the electricity mix must come from renewable energy sources such as wind, solar, or geothermal. California currently has a dual RPS mandating that 20% of electricity must come from renewable sources by the end of 2010 (which was not achieved), and 33% by 2020. The mandate of 20% by 2010 is a legislative mandate from SB 107 of 2006. The mandate of 33% by 2020 was adopted by ARB in July 2010.⁶⁵

As a result of the state's RPS, utilities and renewable energy generation companies are proposing the development of land for solar and wind, as well as for right-of-ways for new or expanded transmission lines to bring the generated electricity into the grid at population centers. Utilities will also be looking for renewable electricity to buy in long-term agreements. An example is Westlands Water District, which is planning on converting fallowed farmland to a 5 gigawatt (GW) solar power plant over the coming years. This could provide opportunities for new green jobs in some areas of the Sierra. At the same time, renewable development impacts to sensitive ecosystems and habitat corridors need to be closely considered and avoided or mitigated.



Photospin.com

Increasing the number of wind turbines can help California meet its renewable portfolio standard (RPS).

Land Use Laws and Regulations

Land use and transportation in California make up the largest component of the state's emissions footprint — nearly 40% — with the bulk of those emissions coming from cars and light trucks. In building out sprawling development, governments and consumers emit extensive carbon from travel and from building and maintaining extensive infrastructure and services over a larger-than-necessary area. A June 2010 study by Calthorpe Associates estimates that taxpayers could save \$194 billion dollars in capital infrastructure costs by 2050 by supporting infill development.⁶⁶ Additionally, sprawl reduces farming and ranching incomes, decreases the scenic open space that attract tourists, and increases the cost of services.

To address this significant problem, and as part of AB 32's implementation, the legislature passed SB 375 in September 2008 to reduce emissions through improving land use and transportation planning. To achieve these reductions, SB 375 uses the regional transportation planning process to integrate transportation planning with land use planning and regional housing needs. The emissions reductions would result from people driving less by living in more walkable and bikeable communities and having access to public transportation options. By making sure that homes affordable to all economic segments of the population are in every community, the excess driving caused by economic segregation can decrease as well. The legislation strives to reduce vehicle miles traveled (VMT) in a way that also ensures cleaner air and healthier residents. According to ARB's scoping plan for AB 32, SB 375 is meant to account

A June 2010 study by Calthorpe Associates estimates that taxpayers could save \$194 billion dollars in capital infrastructure costs by 2050 by supporting infill development.

for a minimum of 5 MMT of emissions reductions by 2020, and is a significant effort and an important shift in planning and zoning priorities and processes. Further, the SB 375 planning process provides accountability by ensuring that the billions of dollars spent on transportation achieve the best possible outcomes on traffic, air quality, residents' health, and families' budgets.

A primary vehicle for reductions in SB 375 is the requirement for Sustainable Community Strategy (SCS) development by regions. It is an added component to the federally mandated Regional Transportation Plan (RTP) but more comprehensive in its integration with land use planning and housing needs allocation. In early 2010, the California Transportation Commission released their draft update of guidance regarding RTPs. Under SB 375, ARB is required to update regional GHG reduction targets every eight years in line with each RTP update.

Most Sierra communities are not required to undertake SB 375 planning due to the Sierra's rural nature. Only four Sierra counties are members of a Metropolitan Planning Organization (MPO), which is the entity that conducts regional planning under SB 375. However, all Sierra counties, with the exception of Lassen, Plumas, Mariposa, and Madera counties, are members of a local Council of Government (COG) which can be a major forum for regional planning. These COGs are important planning venues, but can differ in their objectives. As a result, more coordination is needed between them on regional planning issues.

Sierra communities should take the opportunity to go through community visioning processes under SB 375 in order to choose the direction of their county and reduce air pollution and public health impacts of their General Plans. Additionally, the funding pools available for SB 375 are often open to counties looking to integrate their land use and transportation planning or update zoning to match General Plan guidelines. For more information on funding for land use planning, see the sidebar on page 33 in the section "Opportunities to Reduce Emissions During Land Use Planning".

Another incentive for Sierra communities to implement regional planning processes similar to those under SB 375 is the potential for spillover sprawl from neighboring counties that are conducting SB 375 plans. Without a concrete plan for where growth should be placed, embodied in the General Plan and zoning documents, it will be more difficult for Sierra counties to guide development to desirable locations and maintain their rural character. Integrated regional plans can help direct development into locations in line with community priorities.

The Sierra Nevada Conservancy's Climate Action Plan

In late 2009, the Sierra Nevada Conservancy (SNC), a state agency that “supports efforts to improve the environmental, economic, and social well-being of the Sierra Nevada Region,” completed its Sierra Nevada Climate Action Plan (CAP) for the region. The plan recommends primary strategies and actions for the region with respect to reducing emissions and adapting to the effects of climate change. Though more heavily focused on adaptation actions, which are covered later in this toolkit, the plan also includes a section on “Reducing greenhouse gas emissions region-wide through support for local government efficiency and land use efforts.” Specific recommendations of what the agency should do include:

- Conduct community outreach that shares ‘best practices’ of climate/sustainability documents that communities and their local governments can use as model plans.
- Share information on the importance of smart growth development and land use planning to address GHG emissions.
- Share information on energy efficiency programs with local utilities.
- Build a model educational plan that includes identifying how to create a local climate action plan.
- Identify appropriate public transit strategies for remote rural communities that address the economic impacts of climate change and opportunities for reducing the community’s carbon footprint.

The full plan is available on the Conservancy’s website at http://www.sierranevada.ca.gov/docs/climate_action_plan.pdf. For more information on the plan’s efforts relating to climate change adaptation see Chapter 4.

Incorporating Emissions Reduction into Existing Sierra Planning and Projects

As you can see from the sections above, the national, state, and regional governmental responses to climate change are still in their early stages with many planning processes, funding mechanisms, and emission reduction systems not yet complete. The remainder of this chapter addresses:

- Tips and resources for conducting a greenhouse gas inventory
- Addressing emission reduction during environmental review processes
- Reducing emissions in:
 - ◆ land use planning
 - ◆ forestry planning
 - ◆ water planning
 - ◆ energy planning and development
- Tips for community action

Conducting a Greenhouse Gas Inventory

This toolkit will not provide the details necessary to do an inventory, but a summary of steps, tips for success, and resources to learn more. The first step to reducing greenhouse gas (GHG) emissions in a project, existing operation, or region is to understand where they are coming from and in what quantities. Cities and towns conducting such an inventory should budget \$25,000-\$35,000 for a full inventory, though rougher estimates can be completed for less money. Once the amounts and sources are quantified, strategies for reducing emissions can be identified. A greenhouse gas inventory may be required in order to gain permits for the project. The Climate Leadership Initiative at the University of Oregon identifies the steps of a greenhouse gas inventory as:

1. Define the goal and scope of the inventory.
2. Collect emissions data for greenhouse gases (GHG).
3. Calculate GHG emissions data, and convert to CO₂ equivalents as a common unit.
4. Interpret the inventory by identifying major emissions sources and determining ways to achieve reductions.⁶⁷

When conducting your inventory, the Sierra Nevada Alliance recommends the following:

- **Choose a broad, but practical scope:** Greenhouse gas inventories can be complex sets of data and should be completed with care to ensure that all emissions within your defined scope are accounted for. Likewise, determining the project's scope is an important step because it will determine what information you see and ultimately what reductions you can choose to make. Too narrow of a scope may cause you to ignore a significant source of emissions, such as one you have passed on to a contractor. Too broad of a scope, and your inventory may be impractical.
- **Use Life Cycle Analysis (LCA) when choosing solutions:** When choosing methods for reducing emissions, it is important for planners to understand the actual impact of the solutions being chosen. Life cycle analysis, which accounts for the total emissions created in manufacturing and delivering a product, should be used to the extent feasible when choosing potential solutions to ensure that solutions will perform as expected. Such analysis is important in rural places such as the Sierra to ensure that potentially significant impacts from extended travel and delivery systems are accounted for.

Further Resources

ICLEI – Local Government Operations Protocol – *Quantification and Reporting of Greenhouse Gas Emissions Inventories*:

<http://www.theclimateregistry.org/downloads/2010/05/2010-05-06-LGO-1.1.pdf>

California Climate Action Registry – *Online Inventory and Reporting Tool for State and Local Governments*:

<http://www.climateregistry.org/>

The Greenhouse Gas Protocol – *Standards and Calculation Tools for Businesses and Agencies*:

<http://www.ghgprotocol.org/>

The first step to reducing greenhouse gas (GHG) emissions in a project, existing operation, or region is to understand where they are coming from and in what quantities.

Requirements and Opportunities to Identify Emission Reductions During Environmental Review (NEPA/CEQA)

Conduct a Greenhouse Gas Inventory

- **CEQA and NEPA require quantification of emissions:** In addition to the review of GHG emissions for federal projects being proposed in new NEPA guidelines, CEQA guidelines adopted in early 2010 now require a good faith effort to quantify the GHG emissions of any project. Additionally, the guidelines specify that the Environmental Impact Report (EIR) must discuss the project's GHG impacts in the context of regional goals of new planning laws such as SB 375.
- **Address GHG emissions in County General Plans and other programmatic documents:** Critical planning documents such as General Plans and agency-wide plans that cover an activity that encompasses multiple future project sites are opportunities to streamline the environmental review process and address GHG emissions. The California Attorney General's Office recommends using programmatic documents as a way to address GHG emissions that are difficult to tackle at the project level. Also, if the plan or programmatic environmental document adequately analyzes GHG emissions, approval of subsequent individual projects under it can sometimes be streamlined.
- **A greenhouse gas inventory can be informative for broader projects:** Lead agencies can use the CEQA process as a launching point for greenhouse gas inventories of their entire program's work and identifying what common cross-project emissions are avoidable or reducible.

In the Sierra, average vehicle miles traveled (VMT) per person increased by 30% between 1990 and 2000, while population grew by just 16%.

Identify Comprehensive Emission Reduction Strategies

- **CEQA requires mitigation of significant impacts:** When CEQA analysis identifies potential environmental impacts, including climate change, the lead agency is required to implement mitigation measures. This requirement makes the CEQA process a good time to identify emissions reduction strategies or get feedback from the public on planned strategies.
- **NEPA requires mitigation of significant impacts:** While the NEPA guidelines for GHG reductions remain in draft form as of the date of this publication, projects requiring a NEPA analysis should still account for and reduce GHG emissions as a significant environmental impact under NEPA.
- **Include strategies with multiple benefits:** When choosing strategies for mitigating GHG emissions, lead agencies have the opportunity to identify low-cost projects with other environmental and resource benefits. Potential projects with co-benefits include energy and water efficiency measures, which are often net-positive in cost within a few years and provide climate change adaptation benefits by helping the project be resilient in the face of future changes in resource availability.

The National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA)

NEPA

NEPA, enacted in 1970, is the base of U.S. environmental law. The Council on Environmental Quality (CEQ) describes NEPA as a “fundamental tool to harmonize our economic and environmental aspirations. It recognizes that many federal activities affect the environment and mandates that federal agencies consider the environmental impacts of their proposed actions before acting. NEPA emphasizes public involvement in government actions affecting the environment by requiring that the benefits and the risks associated with proposed actions be assessed and publicly disclosed.”⁶⁸

More specifically, before a federal agency or entity acting under federal funds or federal permits takes a major action, NEPA requires significant reporting of environmental impacts including ecological, aesthetic, historic, cultural, economic, and social, or health impacts, whether adverse or beneficial.⁶⁹ It must also determine methods to reduce the significant impacts of the project and consider alternative projects with less impact on the environment. Following the reporting, the agency must allow time for review and comment by the public and respond to those comments before issuing its final Environmental Impact Statement.

CEQA

CEQA is a California law requiring disclosure and public involvement in decisions that have the potential to harm the environment. This act allows Californians to actively participate in planning and development issues in their communities by reviewing environmental documents, submitting written comments, and attending hearings.

In practice CEQA operates by requiring state and local government agencies to thoroughly examine environmental concerns when making decisions and to make the process open and accessible to the public. Specifically, before any public agency undertakes or approves a project that agency must:

1. identify potentially significant environmental effects of the project
2. choose alternatives that would avoid or substantially lessen the significant environmental effects
3. mitigate the significant environmental effects, where feasible.

CEQA is required for almost any development proposal or land use planning process at the local level, including General Plans.

Further Resources

Attorney General's Climate Change Portal – California Attorney General's Office:

<http://ag.ca.gov/globalwarming/>

Addressing Climate Change at the Project Level – California Attorney General's Office:

http://ag.ca.gov/globalwarming/pdf/GW_mitigation_measures.pdf

CEQA and General Plans – California Attorney General's Office:

<http://ag.ca.gov/globalwarming/ceqa/resources.php>

Opportunities to Reduce Emissions in Land Use Planning

Land use planning represents an important opportunity for making changes that will reduce emissions. Land use plans can dictate where development can occur, the form of the development, and at times even the building standards. When done with foresight, land use plans can set the priorities for the next 50-100 years of sustainable development. When done for short-term gain, it can lock in decades of harmful emissions.

New land use development produces GHG emissions in three ways: through energy used in the buildings (for heating, cooling, landscaping, etc.); through energy used to provide services to the development (fire protection, water, sewage); and by influencing how we travel from place to place.

Buildings generate GHG emissions through their significant energy use and the materials used to build them. They account for approximately 40% of total energy use, 71% of electricity use, and 33% of all CO₂ emissions in the United States. Buildings also account for 40% of all materials and wood use and 25% of all water use in the United States. About 30% of energy used in buildings is wasted due to poor design, construction, and inefficient appliances.⁷⁰

The location of development can also be a significant contributing factor in GHG emissions. Sprawling, low-density development encourages long hours in the car, while compact, mixed-use development encourages walking, bicycling, using public transit, or driving shorter distances. About 40% of California's GHG emissions come from transportation, and these are



Nevada City's vibrant downtown is an example of how historic Sierra communities can support local businesses, promote walking and biking, and reduce greenhouse gas emissions through city-centered land use planning.

Travis Thurston

directly linked to sprawling land use patterns that encourage driving. In the Sierra, average vehicle miles traveled (VMT) per person increased by 30% between 1990 and 2000, while population grew by just 16%. This indicates that the majority of Sierra land use patterns encourage people to drive longer distances, which in turn increases the amount of GHGs emitted.

Utilizing the planning principles laid out in SB 375 can help turn around such trends. For rural counties, integrated land use planning in the style specified in SB 375 remains the primary tool for reducing emissions in planning. In many cases, community centered growth for new development is going to be an important strategy for Sierra rural counties and cities.

The Sierra Nevada Alliance recommends the following for land use planning and preserving Sierra's historic, rural communities:

Choose Locations that Reduce Emissions

- **Prevent dispersed, sprawling growth:** Plan development so that growth moves outward in a contiguous pattern in order to reduce transportation emissions from residents driving long distances to meet basic needs. Compact development patterns bring investment and vitality into downtowns, create connected neighborhoods, and support the local economy. The Sierra County General Plan and the recently-adopted Mariposa County General Plan provide for community-centered growth. Both counties have traditional communities where residents and visitors can walk to many activities, and the policies within the General Plans encourage development near urban cores and discourage sprawl in open spaces not served by current infrastructure.
- **Identify and utilize infill sites whenever possible:** Infill development represents an opportunity to revitalize existing areas and bolster local culture while reducing GHG emissions. In general, infill development requires less infrastructure, reduces travel costs, sells at higher prices, and decreases environmental impacts.⁷¹ A study in Florida found that an infill housing development consumed 73% less open space per housing unit than developing an untouched (greenfield) site.⁷²
- **Make use of existing infrastructure:** Building out new infrastructure for one new development encourages further development to match that infrastructure's capacity. Placing new development in places with existing transportation, water, sewer, and energy infrastructure will reduce costs and encourage additional compact development, resulting in fewer GHG emissions.
- **Adopt zoning in line with the regional or General Plan's minimum standard:** After adopting planning documents, local governments must update zoning codes in order to ensure that the visions and requirements in the documents are realized. Since zoning is a critical follow-up step to planning that requires additional time and money, local governments sometimes do not complete the process. The Strategic Growth Council (SGC) has planning grants available for cities and counties to do such planning.

Plan for Compact Community Form

After a community adopts planning and zoning documents that broadly describe the location of services, the next step is to define the form new development will take. A community's form includes street widths and vehicle speeds, how far from the street buildings should be placed, what services buildings can provide, and general transportation options. Planning for community form provides an opportunity to maintain rural character, improve safety, and decrease emissions in an area through mixed use and high density developments and supportive street-side codes. A primary barrier to good community form in many Sierra towns is out of date zoning codes that mandate excessive minimum parking or housing setbacks. Such codes have been shown to be detrimental to community form and can be replaced with zoning codes that result in walkable communities. By planning for these benefits, Sierra communities can preserve their rural character while also significantly reducing local GHG emissions from transportation.

To find out more about land use planning in the Sierra, check out the Sierra Nevada Alliance publications *Planning for Water-Wise Development in the Sierra: A Water and Land Use Policy Guide*, *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada*, and *Planning for the Future: A Sierra Nevada Land Use Index* at www.sierranevadaalliance.org.

- **Design developments for mixed use:** Zoning and developments that include mixes of commercial and residential in the same building or the same area, such as those in historic Sierra communities, support compact community form, economic development, affordable housing, jobs-housing balance, and pedestrian-oriented design. By providing multiple services in one area, such as a small downtown, planners can strengthen communities and reduce transportation-related emissions.
- **Plan for higher density communities:** Density requirements that promote vibrant communities are a major component of reducing emissions for mixed use, rural communities. By preventing sprawl from spreading onto surrounding hillsides, planners can help protect a community's character and charm while also reducing emissions and making the town safer in the event of a wildfire. Removal of height limits, minimum lot sizes, and inflexible building setbacks enables builders to more flexibly incorporate higher densities and better community form.
- **Incorporate "Complete Streets" into development designs:** To enable stronger communities and reduce emissions, planners should design roads so that they provide a multi-purpose transportation network of roadways, streetscapes, and trails that connect various parts of the community. "Complete Streets" meet the needs of pedestrians, ensure safety, create visual appeal, and allow efficient access to multiple modes of transport. Planners can reduce minimum parking requirements and utilize shared parking to reduce pavement and enable walkability.

Incentives and Funding for Climate Change Planning

- EPA's Climate Change Showcase Communities Grants: <http://www.epa.gov/statelocalclimate/local/showcase/index.html>
- Strategic Growth Council Planning Grants: http://www.sgc.ca.gov/planning_grants.html
- Housing and Urban Development Grants: <http://portal.hud.gov/portal/page/portal/HUD/topics/grants>
- HUD-DOT-EPA Partnership for Sustainable Communities: <http://www.epa.gov/smartgrowth/partnership/>

Require Region-Friendly Site Design

Emissions can be reduced by the design of the site and building by keeping in mind energy and water efficiency. The layout of sites and building design are generally beyond the scope of this toolkit. Recommendations to reduce emissions are frequently site specific, based on the characteristics of the site and region. Generally, however, reducing or being more efficient in the use of any resource is sound economic policy and effective for reducing emissions. Where possible with respect to a project's scale, measures related to site design should reference the site or local area's greenhouse gas inventory in order to better inform best practices. When approaching site design specifications, experts and publications directly dealing with reducing individual emissions should be consulted.

- **Replicate or Restore Natural Hydrology Through Low Impact Development (LID):** LID takes a holistic approach to land use planning and engineering design, seeking to mimic nature's hydrologic cycle within an urban area using small, natural features to collect, treat, and convey stormwater runoff. Green roofs, rainwater harvesting, bio-retention areas (or rain gardens, bio-swales), permeable pavement, tree planting, and riparian habitat protection are among the most commonly used LID and green infrastructure techniques. These techniques have many benefits including enhancing local water supply, improving water quality, saving energy, reducing GHG emissions, and saving money that would normally be invested in large, costly end-of-pipe facilities located at the bottom of drainage areas.⁷³

For example, a recent study by the Natural Resources Defense Council and University of California, Santa Barbara's Bren School of Environmental Science and Management showed the potential water-energy savings of LID strategies: 1.2 million megawatt hours of electricity per year could be saved by creating low-energy local water supplies rather than developing energy-intensive imported or desalinated water.⁷⁴ The energy saved by implementing LID techniques, in this case, could power more than 102,000 single-family homes, with a carbon emissions reduction equivalent of taking nearly 100,000 cars off the road.⁷⁵ For more information on LID techniques, consult the Sierra Nevada Alliance's *Planning for Water-Wise Development in the Sierra: A Water and Land Use Policy Guide* at <http://www.sierranevadaalliance.org/publications/>.

Utilize Existing Funding and Planning Opportunities

- **Save time, effort, and money by utilizing existing planning processes:** The smart growth and emissions reduction strategies in SB 375 are useful for counties and cities. Having strong plans that integrate transportation and land use planning can help communities prevent undesirable air quality, public health, and livability impacts from encroaching urban areas. Funding is often available to conduct these sorts of integrated plans, which can potentially offset the costs of an already required General Plan or Regional Transportation Plan (RTP) update.
- **Take advantage of existing incentives and funding:** The Strategic Growth Council, Department of Housing and Urban Development, and the Environmental Protection Agency all have funding for community and regional planning. See the sidebar on page 35 for details on funding for climate change planning.

- **Use the RTP/SCS process to implement smart growth principles between General Plan updates:** RTPs and SCSs must be updated every four years by federal law, and as such are major opportunities to begin reducing emissions immediately. These updates can set the stage for smart community growth that avoids additional emissions by shifting transportation investments from highways toward transit, sidewalks, bike lanes, and bike paths. Additionally, planners can include provisions for new or improved bus systems that designate existing centers for new development. Many of these strategies provide an attractive service for tourists as well. Finally, investment in public transportation over highway projects has been shown to produce more jobs. For example, stimulus funding from American Recovery and Reinvestment Act of 2009 produced twice as many jobs per dollar invested in public transportation than in roads.⁷⁶

Opportunities to Reduce Emissions in Energy and Water Planning

Energy and water are the two most important resources at the base of our economy. These systems depend heavily on each other. Ultimately, energy usage is the source of the vast majority of GHG emissions – we burn fossil fuels for heat, electricity, manufacturing, and transportation. Nearly 20% of the state’s electricity use is water related which means it is energy used in the capture, movement, treatment, distribution, heating and end-uses of water.⁷⁷ The result is that increased demand on energy systems impacts waters supplies, and increased water demand requires more energy usage and creates more carbon emissions.

Strategies to reduce carbon emissions from energy and water usage fall into two main categories:

- **Efficiency and Conservation** – Get more out of each unit of energy or water. Essentially, use resources more wisely to make them go further. This results in using less.
- **Reduce Carbon Intensity** – Reduce the amount of GHGs required to produce, process, or deliver each unit of energy or water. Planners achieve this reduction through clean energy programs.

The following are recommendations for reducing emissions in water and energy planning:

Identify opportunities that reduce emissions and prepare for a range of future scenarios

- **Create or Bolster Efficiency and Conservation Programs:** Currently, water-related energy use accounts for approximately 20% of the state’s electricity usage and 33% of the state’s natural gas consumption. Due to the energy required to transport, heat, and treat water, the cheapest and least carbon intensive drop of water is the one you never use. Efficient use of water has the added benefit of making a geographic area more resilient to climate change; with expected reductions in water availability, efficient fixtures will require less of the increasingly scarce and expensive resource. Reductions in water use also lower overall demand, potentially saving money on future infrastructure needs, and preventing the need to secure new water rights as an area grows.

Electric energy usage currently accounts for over a quarter of the state’s GHG emissions. Reducing demand for energy through efficient use of the resource and consumer education will reduce direct emissions from electricity sources.

- **Install Water Meters:** State law requires that all water suppliers retrofit all connections with water meters by 2025. Installing water meters as soon as possible creates an incentive for customers to conserve water, which saves water, energy, and money – and avoids carbon emissions. Recently, some water utilities have installed smart water meters that transmit water usage from a residential or commercial unit every 15 minutes. The data collected allows the utility to discover any leaks or issues more quickly. In addition, consumers can access a website to see their water consumption on the 15 minute interval;. The information is a powerful tool to improve consumer education and reduce consumption in general and at peak hours.
- **Price Water to Encourage Conservation:** Implementing socially optimal pricing models for water (such as increasing block pricing) in conjunction with metering can help encourage lower use rates and further reduce carbon emissions.
- **Educate the Public About Conserving Resources:** Educational programs that teach mindful conservation of water are an important part of reducing water emissions. With per capita water usage at approximately 192 gallons per day statewide and higher in many Sierra counties, educating the public on using less water represents a potentially effective way to cut emissions associated with water use.⁷⁸
- **Install and Create Incentives for Efficient Appliances and Fixtures:** Energy efficiency measures are extremely effective reducers of GHGs that save residents and businesses money in most cases.⁷⁹

For water efficiency, consider programs for retrofitting or replacing equipment, reducing leaks, and recycling water in residential, commercial, and industrial buildings.⁸⁰ Residential water use in California could be reduced by approximately 40% by reducing leaks and replacing inefficient toilets, clothes washers, showerheads, and dishwashers - even without improvements in technology.⁸¹

For energy efficiency, consider programs for retrofitting or replacing equipment in residential, commercial, and industrial buildings. There are many examples of rebate programs and incentives to install energy efficient lighting, heating, and appliances, such as the programs implemented by the Truckee Donner Public Utility District.

Reduce water and energy system losses

- **Conduct a system loss and/or use audit:** Water suppliers can realize significant financial savings and reduce emissions by assessing and repairing water and energy losses from their delivery systems. A 1987 study by the Department of Water Resources found that 47 California water suppliers saved an average of 1.5 acre-feet annually per mile of pipe and over \$2,150,000 by fixing leaks in systems.⁸²

A system ‘use’ audit is also an effective tool to determine the most effective means of energy conservation or investment in upgrades. A system use audit is a system-wide audit to determine waste and to learn what possible home/building or appliance upgrades would provide the greatest return on investment and the shortest payback period.

- **Explore rainwater capture programs:** Capturing rainwater and using it on site can save water and energy. Some California municipalities, such as Long Beach, have implemented pilot programs for residents. Capture systems can be as simple as

redirecting a drain into a barrel for use in landscaping. For systems requiring pumps, conduct an analysis and consult your greenhouse gas inventory to determine whether rainwater capture saves energy and emissions.

- **Recycle water:** Utility-scale water recycling systems offer a significant opportunity to save water and energy. Except for gravity fed water systems, recycled water averages the least energy used per unit of water delivered, saving water and money for utilities and consumers. In some cases, usable power and heat can be generated from wastewater treatment, further offsetting costs. For a more comprehensive look at the myriad benefits of treating waste as a resource – aka Integrated Resource Recovery – consult the Ministry of Community and Rural Development (British Columbia) guide Resources from Waste: A Guide to Integrated Resource Recovery at: <http://www.rivernetwork.org/blog/7/2010/01/22/resources-waste-guide-integrated-resource-recovery>.
- **Use Graywater:** For smaller facilities and homes, reusing water on site as graywater in gardens or other outdoor functions avoids unnecessary transport and emissions associated with septic tanks and major wastewater treatment.

Plan for future water scenarios and options in your region

- **Participate in your local IRWM:** Integrated Regional Water Management Plans (IRWMPs) enable watershed stakeholders to come together to decide the future priorities and management of their water. Stakeholders should look into setting feasible regional water efficiency targets to reduce GHG emissions and implementation of water conservation strategies in the plan with grant funding from the Department of Water Resources IRWM grant program.
- **Use long-range planning documents to reduce emissions:** Many water plans, such as Drought Preparedness Plans and Urban Water Management Plans, are excellent avenues for analysis of options to use less water. For more complete information on water planning, see the sections of this toolkit that deal with adapting to climate change.

Use low-carbon energy sources

- **Use existing clean energy incentive and installation programs:** The state and federal governments, as well as some companies, have incentive programs to install clean energy systems and energy efficient appliances. These programs can significantly reduce the up-front costs of these emission reduction techniques. To figure out what incentives are available in your area, visit Energy Upgrade California, a website from the State of California that tracks and organizes financial incentive programs for energy measures, at <http://www.energyupgradecalifornia.com/>.

Funding Opportunities for Water and Energy Conservation

- California Department of Water Resources - Integrated Regional Water Management Planning grant program: <http://www.water.ca.gov/irwm/>
- U.S. Department of Energy: <http://www1.eere.energy.gov/financing/>
- California Energy Commission: <http://www.energy.ca.gov/contracts/index.html>
- California Department of Conservation: http://www.conservation.ca.gov/index/Pages/qh_grants.aspx

- **Explore alternative financing measures for on-site and distributed clean energy:** On-site and distributed clean energy systems often avoid the significant infrastructure requirements of utility-scale energy systems. Recent financing mechanisms for dealing with the fixed costs of a solar energy installations have significantly reduced the up-front barriers to implementation of clean energy. Two potential mechanisms are:
 - ◆ *Property-Assessed Clean Energy (PACE)* loans allow cities and counties to take out a bond to create a pool of funding to loan to local residents and businesses for the installation of clean energy systems or efficiency retrofits. The debt is assessed to the property where the residence or business installs the improvements. The balance of the loan can then transfer along with the deed if the property is sold. The gradual payments and quick returns, along with the credit of the city or county, help make PACE financing an effective way to finance clean energy on-site and a solution with significant emission reduction potential for properties with good solar exposure. PACE loans are currently not available at the time of publication due to the structure of the loans and lender complaints, but may be available again in the future if structural concerns can be resolved. For more information on PACE financing, see <http://www.pacenow.org>.
 - ◆ *Solar leasing* offers similar benefits to PACE systems in that you can pay for a system gradually and gain the benefits immediately. Solar leasing involves a third party company that owns the panels and installs them on your property and charges you a monthly fee for the use of them. The energy generated is yours, just as if you owned the panels, and can be sold back to the grid when you generate extra electricity. In most cases this monthly fee is less than a normal energy bill, making leasing another viable mitigation solution for property owners.
- **Treat waste heat as a resource:** For large facilities and developments, explore the possibility of piping waste heat from operations to other parts of the facility for use as part of facility heating. In addition to preventing the use of additional energy for heating, utilizing waste heat can save money in many situations.
- **Appropriately locate clean energy facilities:** Clean energy facilities can have impacts on local water supplies, habitats, and infrastructure. When considering large-scale clean energy developments, ensure that local considerations are taken into account to avoid trading carbon emissions for other local problems.

Further Resources

Water-Energy Calculator – *The Pacific Institute*: <http://wecalc.org/>

Water-Energy Toolkit – *River Network*:

<http://www.rivernetwork.org/resource-library/water-energy-toolkit-understanding-carbon-footprint-your-water-use>

Waste Not, Want Not – *The Pacific Institute*:

http://www.pacinst.org/reports/urban_usage/waste_not_want_not_exec_sum.pdf

Energy Upgrade CA - *California Energy Commission & California Public Utilities Commission*:

<http://www.energyupgradecalifornia.org/>

Water Conservation Tracking Tool – *Alliance for Water Efficiency*:

<http://www.allianceforwaterefficiency.org/Tracking-Tool.aspx>

Forestry Considerations in Emissions Reduction

Forests have long been key parts of the planet's carbon balance. Plants pull carbon out of the atmosphere as they grow, transfer carbon to other organisms as they are consumed or as they decay, and emit it to the atmosphere as they burn. While these processes were in balance, recent human activities, such as fire suppression, logging, and other harvesting operations have impacted that balance. In recent years, efforts have been made to involve forests in large-scale emissions reduction strategies. For example, new proposals have arisen to use Sierra forests as tools to pull carbon out of the atmosphere to prevent accumulation. Other proposals involve burning wood for power in order to avoid fossil fuel use. All such proposals must be evaluated carefully and in consideration of their full impacts on the forest ecosystem and the atmosphere. Furthermore, any proposal that involves Sierra forests in emission reduction strategies must manage for forest and ecosystem health first, and then manage for other benefits.

- **Consider smart biomass projects as an adaptation strategy:** While often touted as a strategy to reduce emissions, biomass projects vary significantly in their emissions based on fuel sourcing, the type of power they replace, and generation methods. Biomass power is more effective as a potential beneficial byproduct of restoration and fuels-reduction efforts in the wildland-urban interface (WUI). For a larger discussion of biomass power and the considerations for managers to critically evaluate proposals, see page 85.
- **Keep abreast of developments in forest carbon credits:** As the global market for carbon offsets grows, Sierra forests will increasingly be a choice for forest carbon sequestration projects. While the long term impacts on forest management remain uncertain, new business stakeholders related to forest carbon storage will likely become players in forest management on public and private lands. Forest management agencies and groups should track laws and incentives introduced as part of the AB 32 process and any national and international programs in order to voice concerns and help shape forest programs that are beneficial to Sierra communities, economies, and ecosystems.

In particular, Sierra managers should pay attention to the implementation of AB 32's Forestry Protocol, which is already raising concerns as clearcutting, which causes irreparable harm to Sierra forest ecosystems, has been proposed as a legitimate strategy to sequester carbon. This problem highlights the potential negative repercussions of forest carbon markets that need to be addressed, such as perverse incentives to continue to log forests, to create monoculture tree plantations of less resilient trees, and to potentially even suppress fires in order to keep carbon sequestered. In general, forest carbon programs should manage for forest health first and carbon sequestration as a possible secondary benefit. In many instances, this will mean the release of carbon, such as through naturally occurring, beneficial fires, but it is important to help restore balance to our forest ecosystems.



Emission reduction strategies involving forests should consider full impacts on forest ecosystems and promote ecological resiliency.

“Summit Sequoia, Yosemite” ©ElizabethCarmel.com

Tips for Community Members

Even for organizations on the forefront of climate science and mitigation, action does not occur overnight. Determining the optimal solutions for a community involves not just a good greenhouse gas inventory and a great idea, but input from community members and subject experts. Finally, those with the ultimate decision-making power must approve the solutions that are decided upon and often need convincing of the action's worth. Broad involvement by community members and concerted efforts will help ensure that the solutions that are drafted are successful.

- **Tell local leaders and agencies you want action to reduce emissions:** Many local officials and agency heads will not have heard of strategies for reducing emissions in their sector or are not immediately amenable to such changes without more information. Attend public meetings, write letters, and join groups to inform them that, as a constituent, you expect them to pay attention to climate change issues. Point them to strategies and information for their type of work, such as those in this toolkit if applicable.
- **Educate your community on relevant issues:** Start or join community groups that deal with climate change or issues of local sustainability. Educating your community on local impacts is often an effective step in gaining broad support to inspire action from local leaders. Once they are educated, provide them with opportunities to show their support for emission reduction. Use petitions, postcards, sample letters, bumper stickers, and other means to demonstrate wide-spread support for emission reduction. For excellent guides on starting local education and advocacy movements, see <http://www.energysavingtrust.org.uk/cafe/Green-Communities/Guidance-and-useful-tools/How-to-Guides> and <http://cbtadaptation.squarespace.com/>.
- **Submit comments during public meetings and review processes:** Most planning processes have built in avenues for public comment. Getting involved through these processes can raise the profile of emission reduction options in your community and inform the decision-maker of options. Attend meetings and submit written comments containing information on projected impacts of the action and alternatives when necessary. Ask local experts to submit factual comments regarding the proposed action. Consider consulting legal assistance to help craft strong comments. Recognize that commenting is only one forum to educate and inspire decision-makers and often not the most effective tactic by itself.

Monitor and engage in regional planning processes: Getting involved in planning processes beyond submitting comments can be a strong way to influence community planning to take climate change emission reduction and adaptation into account. Community groups representing diverse interests should get involved in order to equitably direct land use decisions and create community-centered growth and public transit options.

For more information and strategies on developing a successful campaign to address climate change in your local community and communicating climate change, please see the Sierra Nevada Alliance's publication *Saving Sierra Places: An Activist's Toolkit for Winning Land Use Campaigns*.

Top Ten Ways Individuals Can Save Carbon

The U.S. contributes 20% of the world's greenhouse gas (GHG) emissions, with rural communities having higher per capita GHG emissions than urban areas. The Sierra is mountainous and rural, making it a critical place for individuals to reduce emissions to do our share for future generations.

How you can reduce your personal carbon footprint:

1. Drive Less and Share Rides More

Two of the easiest, healthiest, and most efficient ways to reduce your footprint is to drive less and drive a fuel-efficient car. Each mid-size car emits approximately one pound of CO₂ per mile. Taking longer trips? Try a ride-share through Craigslist to save on gas and GHGs.

2. Get a Free Energy Audit From Your Local Utility Company

Most energy providers offer free energy audits or have tools and resources for you to conduct your own. Contact your local utility to get an auditor to inspect your home and monthly billing statements to determine how you can save energy and money on your gas or electric bill.

3. Monitor Your Big Appliances

Wash clothes on cold cycle and dry on a clothesline or drying rack. Traditional dryers use about 4,000 watts of electricity per day of use — enough to power more than 200 energy-efficient compact fluorescent lights (CFLs.). Plus, air drying helps your clothes last longer and smell nicer. Use the dishwasher, but set it to drip dry. Also, check to make sure the refrigerator door closes properly and there are no leaks around the seal.

4. Drink Tap Water – Saves Carbon

Bottled water is resource intensive and unnecessary. Generally, bottled water is no cleaner, safer, or healthier than tap water. In fact, as much as 40% of bottled water is bottled tap water. In addition, 86% of plastic water bottles end up in landfills instead of the recycling bin. Plus most Sierra tap water tastes great. To learn more about tap water and bottled water facts, visit: <http://takebackthetap.org/>. Save Money and Energy on Lighting

Install CFL or LED light bulbs, which are at least 75% more efficient than their incandescent counterparts. Also, remember to turn off lights when not in use, especially outdoor lights.

5. Eat Local Food

California is the top nationwide food producer. Support your local food producers and reduce emissions associated with long-distance food transport. Enjoy delicious, healthy, local produce at the farmer's market or join a Community Supported Agriculture (CSA) program. To find out about a local CSA program near you, visit <http://www.naturaltradingco.com/csa.html>.

6. Use Power Strips

If it's plugged in, it's pulling power, even if it's turned off. About 10% of the electricity you use is wasted through "phantom loads", which is when a device or charger uses power while it's turned off or not in use. Put electronics on power strips and turn them off when not in use.

7. Buy Energy Star and WaterSense Appliances

Energy Star labels indicate appliances that conserve energy without sacrificing performance and WaterSense labels indicate appliances that conserve water without losing performance. The label applies to washers, TVs, refrigerators, computers and more. Recycling old appliances and purchasing new energy star appliances with rebates may have a short payback period and a big return on investment. Also, utilities often offer additional rebates. Visit www.energystar.gov and www.epa.gov/watersense/ to learn more and find great rebates on products with these labels.

8. Conserve Water

Inside

Approximately 20% of California's electricity is used for the transport, treatment, and use of water. 60% of that energy is used for residential water supply and water heating. Take shorter showers, install an ultra-low flow showerhead and turn down the water heater a few degrees to save energy and water.

Outside

All water in the state will be metered on a pay per use basis by 2025. Most water waste occurs outside. Conserve water in the garden by using native and drought tolerant plants and grasses and installing low-volume sprinkler systems.

9. Heating & Cooling

Turning your thermostat down 10° to 15°F for eight hours in the winter can save 10% a year on your heating bill. Likewise turning it up by 10° F in the summer can save money on your cooling bill. Set your thermostat to 50° or 55° in the winter when you go to bed and when you leave for work. A programmable thermostat allows you to set a customized heating and cooling schedule.

For more fun and easy ways to reduce your footprint, go to Brighter Planet's "Personal Actions" website <http://brighterplanet.com/personal-actions> and see how much carbon you can save!

Chapter 4: Adaptation: Preparing for Future Climate Change in Existing Sierra Planning Processes

The previous chapters explored the potentially harmful impacts climate change may have on our natural resources and local communities as well as the how to reduce our greenhouse gas (GHG) emissions in order to prevent possible future catastrophic scenarios. The science shows that we have already altered our climate over the past 150 years, and that even if we drastically reduced our greenhouse gas emissions today, we have already set in motion changes to our planet for which we need to be prepared. In the face of climate change impacts we need to plan and act now to protect the unique attributes of the Sierra -- our working landscapes, rural character, recreational paradise, and unique ecosystems.

The goals of this chapter are to:

- Provide up to date information on new national, state, and regional direction to address adaptation, and explain existing incentives and funding opportunities to adapt;
- Introduce the Sierra Nevada Alliance's basic Climate Change Adaptation Principles for planning; and
- Present useful resources and case studies.

New National Direction and Mechanisms to Address Climate Change Adaptation

The new federal administration under President Barack Obama is taking steps to develop a National Adaptation Strategy. In 2009, an Interagency Climate Change Adaptation Task Force was formed composed of the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA). On October 5, 2009, President Obama signed "Executive Order on Federal Leadership in Environment, Energy, and Economic Performance." The order required the Task Force, with assistance from all agencies, to develop recommendations for adapting to climate change impacts internationally, as well as within the United States, within one year.

The final interagency report of the Task Force was released on October 14, 2010. The report outlined five priority actions for this interagency work on adaptation: 1) Make adaptation a standard part of agency planning, 2) Ensure scientific information about the impacts of climate change is easily accessible, 3) Align federal efforts to respond to climate change impacts that cut across jurisdictions and missions, 4) Develop a U.S. strategy to support international adaptation, and 5) Build strong partnerships to support local, state, and tribal decision-makers in improving management of places and infrastructure likely to be affected by climate change.

The report also identified the following guiding principles, similar to the Sierra Nevada Alliance’s adaptation principles, to guide decision-makers in addressing climate change adaptation:

- **Adopt Integrated Approaches:** Adaptation should be incorporated into core policies, planning, practices, and programs whenever possible.
- **Prioritize the Most Vulnerable:** Adaptation strategies should help people, places, and infrastructure that are most vulnerable to climate impacts and be designed and implemented with meaningful involvement from all parts of society.
- **Use Best-Available Science:** Adaptation should be grounded in the best-available scientific understanding of climate change risks, impacts, and vulnerabilities.
- **Apply Risk-Management Methods and Tools:** Adaptation planning should incorporate risk-management methods and tools to help identify, assess, and prioritize options to reduce vulnerability to potential environmental, social, and economic implications of climate change.
- **Apply Ecosystem-Based Approaches:** Adaptation should, where appropriate, take into account strategies to increase ecosystem resilience and protect critical ecosystem services on which humans depend, to reduce vulnerability of human and natural systems to climate change.⁸³

To track the federal government’s progress toward a National Adaptation Strategy, you can check out the Council on Environmental Quality’s website, which includes the Interagency Climate Change Adaptation Task Force’s final report. The website is at: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>.

Beyond the Interagency Climate Change Adaptation Task Force, individual federal departments, agencies, and programs are currently undertaking other activities to support the eventual development of an integrated national adaptation strategy. The research, monitoring, policies, and decisions made at the national level will impact the Sierra Nevada, especially since the majority of land in the Sierra is publicly owned. Furthermore, a lot of great resources, tools, and funding opportunities are being developed at the national level that could be utilized in Sierra planning processes to maximize resources and time.

National Environmental Policy Act (NEPA) and Climate Change Adaptation

The National Environmental Policy Act of 1969 requires all federal agencies in the Executive Branch to go through an environmental impact assessment process or NEPA process before making final decisions on projects with potential environmental effects (See the informational box on page 32 for more information on NEPA). The Council on Environmental Quality (CEQ) is charged with ensuring federal agencies comply with NEPA by issuing minimum NEPA regulations. Each federal agency develops their own NEPA implementing procedures, but these procedures must meet the minimum requirements set by the CEQ and must be approved by the CEQ.

The Environmental Protection Agency (EPA) reviews Environmental Impact Statements (EIS)

to aid federal agencies in making their decisions and posts the EIS and reviews on their website.⁸⁴

For the Sierra Nevada, NEPA is a useful mechanism and opportunity for local stakeholders to get involved and ask the many federal agencies that manage our landscapes to consider and act on climate change issues. The Citizen's Guide to the National Environmental Policy Act is a useful guide to better understand the NEPA process and how you can get involved and provide your thoughts and comments to aid in the decision-making process and make the Sierra Nevada more resilient.

On February 18, 2010, the CEQ issued draft guidance to federal agencies on when and how to consider greenhouse gas (GHG) emissions and climate change impacts through the NEPA process. Here are the key points from the draft NEPA guidance document regarding climate change adaptation:

- “Affirms the requirements of the statute and regulations and their applicability to GHGs and climate change impacts.” [p.1]
- Observed and predicted impacts of climate change must be considered when describing the current environment and the environment that results from the proposed action. The analysis may also include how the agency's action or proposal may “add to, modify or mitigate” those climate change impacts. [p.6]
- NEPA's “rule of reason” determines the level and detail to which climate change should be addressed: “Agencies should consider the specific effects of the proposed action (including the proposed action's effect on the vulnerability of affected ecosystems), the nexus of those effects with projected climate change effects on the same aspects of our environment, and the implications for the environment to adapt to the projected effects of climate change.” [p.7]
- “Where climate change effects are likely to be important but there is significant uncertainty about such effects, it may also be useful to consider the effects of any proposed action or its alternatives against a baseline of reasonably foreseeable future conditions that is drawn as distinctly as the science of climate change effects will support.” [p.7]
- “Climate change effects should be considered in the analysis of projects that are designed for long-term utility and located in areas that are considered vulnerable to specific effects of climate change (such as increasing sea level or ecological change) within the project's timeframe.” [p.7]
- Supports adaptive planning and the value of monitoring. [p.7-8]
- Allows agencies to summarize and incorporate by reference the relevant scientific literature rather than engaging in unnecessary or “exorbitant research of analysis.” [p.8]
- When using climate change modeling in NEPA analysis, agencies should consider and disclose the limitations and uncertainties of those models and the extent to

which they rely on those models. [p.8]

- “Agencies should also consider the particular impacts of climate change on vulnerable communities where this may affect the design of the action or the selection among alternatives.” [p.8]

Furthermore, the current draft guidance does not apply to federal land and resource management actions; instead the CEQ issued the following questions regarding resource management and climate change for public comment. This loophole exempting federal land and resource management actions may negatively impact the Sierra if climate change is not addressed in NEPA documents as so much of Sierra lands is under federal management.

1. How should NEPA documents regarding long-range energy and resource management programs assess GHG emissions and climate change impacts?
2. What should be included in specific NEPA guidance for projects applicable to the federal land management agencies?
3. What should be included in specific NEPA guidance for land management planning applicable to the federal land management agencies?
4. Should CEQ recommend any particular protocols for assessing land management practices and their effect on carbon release and sequestration?
5. How should uncertainties associated with climate change projections and species and ecosystem responses be addressed in protocols for assessing land management practices?
6. How should NEPA analyses be tailored to address the beneficial effects on GHG emissions of Federal land and resource management actions?
7. Should CEQ provide guidance to agencies on determining whether GHG emissions are “significant” for NEPA purposes? At what level should GHG emissions be considered to have significant cumulative effects? In this context, those who provide comments may wish to consider the Supreme Court decision in *Massachusetts v. EPA*, 549 U.S. 497, 524 (2007). [p.11-12]

To track the Final NEPA guidance on Greenhouse Gas Emission and Climate Change by the CEQ, go to: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa>

The Citizen’s Guide to the National Environmental Policy Act: http://ceq.hss.doe.gov/publications/citizens_guide_to_nepa.html

Climate Change Considerations in Project Level NEPA Analysis, US Forest Service, January 13, 2009: http://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf

Specific agency NEPA procedures (like those of the US Forest Service) can be found at this website: http://ceq.hss.doe.gov/nepa_contacts/agency_implementing_procedures.html

Where to find EISs and EAs: <http://www.epa.gov/compliance/nepa/eisdata.html>

In order to track any future federal legislation on climate change adaptation, you can utilize RSS feeds and alerts from OpenCongress (<http://www.opencongress.org/>), the U.S. Library of Congress (<http://thomas.loc.gov/>), or GovTrack (<http://www.govtrack.us/>). You can also subscribe to the Sierra Nevada Alliance Climate Change E-newsletter by emailing info@sierranevadaalliance.org with the Subject: Subscribe Climate Change E-News.

California: A Leader on Climate Change Adaptation

In addition to passing landmark greenhouse gas (GHG) emission reduction legislation (AB 32), California began a process to develop a statewide adaptation strategy in 2008 under the direction of the Natural Resources Agency. That process was given further weight and support when Governor Arnold Schwarzenegger signed Executive Order S-13-08 on November 14, 2008, directing the Natural Resources Agency to lead the effort to address sea level rise and climate change impacts through a statewide adaptation strategy to be finished by the end of 2009. After a round of public comments, the final 2009 California Adaptation Strategy (CAS) was released December 2, 2009. The governors also announced the Climate Adaptation Advisory Panel will further the work of the CAS by developing key recommendations for the governor and legislators on three potential climate hazards: 1) diminishing Sierra snowpack, 2) rising sea levels, and 3) increasing wildfires.

The first iteration of the CAS focuses on how state agencies and departments can change their operations, planning, projects, and grant making to adapt to the predicted effects of climate change. In putting together the strategy, the Natural Resources Agency developed working groups made of representatives from different agencies and departments that would likely be significantly impacted by climate change. Those working groups formulated strategies to address water, public health, biodiversity and habitat, infrastructure, oceans and coastal resources, and working landscapes (forestry and agriculture).

In order to find out more about the CAS, the Natural Resources Agency's future efforts to engage local communities and governments, potential funding opportunities, and useful resources, check out these resources:

1. **California Climate Change Portal:** In addition to providing general information on global and regional climate change and the efforts of the state to reduce emissions, this website includes a section devoted to the California Adaptation Strategy. You can sign up for the adaptation listserve, browse the CAS, and find out the latest events and efforts to address adaptation in California.

<http://www.climatechange.ca.gov/>

2. **Cal Adapt:** A prototype tool created by the Stockholm Environment Institute and funded by the California Energy Commission and Google.org, Cal Adapt uses a Google Earth platform to create a remarkable and easy way to understand visual demonstrations of the potential impacts of climate change to temperature, precipitation, snowpack, wild-fire, and sea level rise in California. This tool is meant to help decision-makers as well as the general public access climate data in a meaningful way and understand the risks presented by climate change.

<http://www.climatechange.ca.gov/visualization/index.html>

Governor Arnold Schwarzenegger signed Executive Order S-13-08 on November 14, 2008, directing the Natural Resources Agency to lead the effort to address sea level rise and climate change impacts through a statewide adaptation strategy



Related to the CAS effort are the climate change related activities of the Sierra Nevada Conservancy (SNC), a state agency whose mission is to “initiate, encourage, and support efforts that improve the environmental, economic and social well-being of the Sierra Nevada Region, its communities and the citizens of California.” In 2008, SNC launched a Climate Change Initiative that included several different efforts to address climate change in the Sierra Nevada. The Sierra Nevada Climate Change Initiative is the umbrella for all the actions, plans and projects regarding climate change within the Sierra Nevada Conservancy. The Sierra Nevada Climate Action Plan (SN CAP), finalized by SNC in 2009, defined specific goals, strategies, actions, and outcomes for SNC and partners to assess, mitigate, and adapt to the current and anticipated effects of climate change. SNC is also working to ensure SNC programs, activities, and priorities, as well their internal operations, are compliant with and supportive of state climate laws, programs, and policy.

The SN CAP is an extensive document and initial start to comprehensively and cooperatively addressing climate change in the region. To get involved, track the process, read the full plan and/or find out more about the SNC’s climate change related activities go to http://www.sierranevadaconservancy.ca.gov/climate_change.html or contact the Sierra Nevada Conservancy with any questions by emailing snclimate@sierranevada.ca.gov.

California Environmental Quality Act (CEQA) and Adaptation

Recently there have been some developments with regard to the California Environmental Quality Act and climate change adaptation (See the informational box on page 32 for more information on CEQA). In 2007, Senate Bill 97 (SB 97) was passed, requiring the Governor's Office of Planning and Research (OPR) to make amendments to CEQA guidelines to address greenhouse gas emissions. While the focus of these amendments was on GHG emission reduction, the final amendments released in 2010 make some initial references to adaptation. The new addition to § 15126.2. ("Consideration and Discussion of Significant Environmental Impacts") requires that the Environmental Impact Report "evaluate the impacts of locating development in other areas susceptible to hazardous conditions (e.g. floodplains, coastlines, wildfire risk areas) as identified in authoritative hazard maps, risk assessments, or in land use plans addressing such hazards areas." [http://ceres.ca.gov/ceqa/docs/Text_of_Proposed_Changes.pdf#page=15] This amendment could be utilized as a mechanism to identify and address climate change impacts through risk assessments and the EIR/CEQA process.

The CAS also identified CEQA as a mechanism for California agencies and departments to address climate change impacts and adapt, providing the following recommendations that would affect Sierra resources (wildlife/forestry) and how CEQA is applied in the Sierra Nevada:

1. The Natural Resources Agency will instruct lead agencies under CEQA Section 15126.2 to "evaluate the impacts of locating development in areas susceptible to hazardous conditions, including hazards potentially exacerbated by climate change." [CAS p. 8]
2. "The Departments within the Natural Resources Agency will continue to use the California Environmental Quality Act (CEQA) process to address the climate change impacts from projects on wildlife, including cumulative impacts." [CAS p. 61]
3. "The Department of Fish and Game will initiate the development of internal guidance for staff to help address climate adaptation and to ensure climate change impacts are appropriately addressed in CEQA documents." [CAS p. 61]
4. "Based on climate change scenarios, the Department of Fish and Game should work to develop thresholds of significance for the adaptive capacity of species related to any direct, indirect, and cumulative impacts of projects." [p.61]
5. "CalFire is proposing revisions to the CEQA guidelines to incorporate more protection for forestland and will work with the Board of Forestry and Fire Protection over the next 18 months to improve review and permitting for forest, timberland, and Timberland Production Zone (TPZ) conversions." [p.116]
6. "CalFire will work with Board of Forestry to consider establishment of CalFire as a trustee agency in CEQA. [CalFire] will provide assurance that new projects and development provide mitigation that is consistent with adaptation goals, including fire safety and forestland conservation and maintenance." [p.118]

Further Resources

SB 97 and Greenhouse Gas Emission Reduction: This OPR website includes background on SB 97 and all documents associated with the update of the CEQA guidelines including the 2010 CEQA guidelines with adopted SB 97 amendments.

<http://www.opr.ca.gov/index.php?a=ceqa/index.html>

Planning and Conservation League: PCL has several resources as well as workshops on how to address climate change through the CEQA process. While these resources currently focus on GHG emissions, their website and staff are useful resources.

<http://www.pcl.org/projects/globalwarming.html>

Attorney General's Office Website: This website contains useful information about CEQA and climate change, specifically with regard to emission reduction. However, the Attorney General's office has been very progressive in addressing climate change, and this is a good resource to track as adaptation comes into the spotlight.

<http://ag.ca.gov/globalwarming/index.php>

Adaptation Principles for Resource Planning

This overview of the climate context in which we are all operating highlights the opportunities opening up at the national, state, and regional levels. As a result of efforts like those of the Sierra Nevada Alliance to educate Sierrans on the impacts of climate change and the need to adapt, many now recognize the importance of addressing adaptation but are not sure how to approach this large and intimidating issue. Over the past four years, the Alliance has promoted a set of principles to help planners, resource managers, conservationists, and others think about and approach adaptation in resource and community planning. In this edition of the toolkit, the Alliance reviews these important principles and how they can be incorporated, along with GHG emission reduction strategies, into various natural resource or community planning processes or projects.

1. Educate ourselves and others on the impacts of climate change.
2. Identify future change through modeling and forecasting.
3. Develop and implement adaptive management strategies.
4. Monitor and track changes in weather, hydrology, ecosystems, and communities.
5. Promote the resiliency of Sierra ecosystems, communities, and economies, and minimize non-climate stressors.
6. Prioritize projects that will succeed under multiple scenarios.
7. Integrate and coordinate local efforts.

1. Educate ourselves and others on the impacts of climate change.

Educate yourself, group, agency, and/or community regarding global, national, statewide, and regional impacts of climate change. The first step to addressing a problem is to understand the challenge. Don't wait—use the information and resources in this toolkit to get the education process started or advanced in your group, agency, or community. Do this now!

Once you have a general sense of how climate change may affect your community, watershed, county, and/or region, identify the existing planning processes and proposed projects in your region. Find out if they are addressing climate change. If not, use the resources from this toolkit, including the chapter on messaging (Chapter 6), to build local support and make the case for integrating climate change into the plan or project.

The best messengers on the impacts of climate change are scientists, water agency staff, resource agency staff, elected officials, and conservation group leaders. Use the resource section in the back of this toolkit to recruit speakers to come to your organization. In the event you do not have time to recruit expert speakers or need assistance, call the Sierra Nevada Alliance staff and we can help.

Once everyone in a planning group, community, or other forum is on the same page regarding the impacts of climate change in the Sierra, it will be easier to address the additional principals below.

2. Identify future change through modeling and forecasting.

Modeling and forecasting tools should be used throughout the Sierra to develop potential future scenarios that can be used as guides for local planning processes. When assessing and learning about resources in your local region, invest in or partner with other organizations doing modeling and/or forecasting to assist in evaluating a range of potential climate change impacts and developing strategies to address those impacts in your region. Complex and expensive computer models and forecasting in a regional context lends greater power to local articulation of climate change impacts.

However, if you can't afford these types of models right away, a first step to take is utilizing other forecasting tools like scenario planning (such as taking the predicted temperature changes for California and planning for those changes in your local city or county) to assist your plan in developing strategies for a broad range of future potential changes. When people see what's going to happen in their own community, it can sway them to action in ways that statements from distant scientists or politicians won't. Furthermore, by planning for a range of potential future scenarios rather than expecting the future to mirror the past, your community or resource management area will be more prepared in the face of climate change.

It is important to remember, however, that models do not predict the future and are only as good as the data that informs them. See "Chapter 8: Resources, Reading & Websites" and the sidebar "Other Approaches and Step-Wise Processes for Adaptation Planning" for more information on models and localized climate impact informational tools.

3. Develop and implement adaptive management strategies.

Because impacts of climate change are not completely known, it is essential to create plans that provide flexibility to adapt to real-world conditions in the future. Rather than striving to maintain current conditions and ecosystems, we should allow for and assist in the adaptation of species and communities. Adaptive management does not assume that the tactics you believe are best at the beginning of a project always turn out to be the absolute best strategy over time. Adaptive management allows for ongoing assessment to adapt tactics and strategies to changing circumstances.

The concept of adaptive management has been applied for centuries under a number of different names. Physical engineers have used this approach since the first structure or bridge was constructed to continually learn from mistakes and successes and improve designs. Adaptive management has a dual nature. First, adaptive management acknowledges that we do not completely understand the system that we are dealing with. It concedes that we will proceed with a project or program using existing information while we gather the knowledge that we lack.

Second, adaptive management is a structured decision-making process that includes the following components, usually in step-wise and cyclical fashion:

- Articulate project goals, outcomes, or success criteria.
- Collect existing knowledge and practices relative to achieving the goals.
- Identify information gaps and related research needs.
- Develop a strategy and apply knowledge and relevant practices towards achieving the clear goals.
- Develop a clearly-defined and defensible monitoring program to determine whether the goals are being achieved.
- Negotiate a pre-defined management response if the goals are not met.
- Reassess and improve practices and reconsider the goals or outcomes.

4. Monitor and track changes in weather, hydrology, ecosystems, and communities.

Ongoing monitoring and tracking of weather, hydrology, and your local ecosystem will provide the best information on the impacts of climate change. If we do not monitor the resources we are managing on a continual basis, we will find changes later on in the game that may be too difficult for any successful adaptation. Continual monitoring is critical for adaptive management and for addressing climate changes. Work with agencies and academic institutions to create ongoing monitoring and data that are scientifically accepted and can guide management.

5. Promote the resiliency of Sierra ecosystems, communities, and economies, and minimize non-climate stressors.

The likelihood that individual species or communities will be able to survive in the face of climate change will depend to a large degree on how resilient they are. Because we still don't know exactly how physical and biological change will happen in the Sierra, utilizing adaptive management and focusing on increasing ecosystem resilience is a far better approach than trying to plan for a specific set of predicted changes.

Furthermore, there are myriad stresses affecting natural systems in the Sierra which will affect these systems capacity to adapt. Air pollution, sprawling development, increasing use of water, and invasive species are examples of problems that degrade ecosystems as well as place a strain on public resources and affect public health. Adaptive actions to protect species, ecosystems, and communities that are sensitive to the current climate should be prioritized. Any opportunity to reduce an existing stressor will provide more ability for ecosystems, species, and communities to handle the stress of climate change.



Oak woodlands are the most biologically diverse areas of the Sierra Nevada but are already experiencing stresses from private land development, mining, and recreational use. Improving land management and protection in this region will help this habitat be more resilient for climate change.

6. Prioritize projects that will succeed under multiple scenarios.

Once you have examined potential future scenarios and developed a plan and strategies, it makes sense to invest in projects and strategies that will be robust enough to succeed under multiple future scenarios rather than a project that will only succeed under a single scenario. Furthermore, “no regrets” strategies or projects that have both emission reduction and adaptation benefits should also be prioritized and implemented first.

7. Integrate and coordinate local efforts.

Addressing conservation issues on a tiny scale when the system works on a much larger scale tends to transfer problems, duplicate efforts, and require greater resources. Integrating and coordinating local efforts and planning helps those in your community, region, and watershed understand the larger ecosystem and human systems. Coordinated efforts allow different entities to share resources, increase expertise, and gain economies of scale. Coordination among very different types of entities also avoids duplication of efforts and promotes more multi-benefit approaches and projects. All efforts should look to network, integrate plans when possible, and collaborate on a regional and greater level.

Special efforts should be made to include stakeholders and allies beyond agencies and local government into these coordinated planning processes including non-profit organizations, tribes, disadvantaged communities, and public health advocates. Including the unique viewpoints, expertise, and needs of these diverse stakeholders will ensure your plan is more robust in addressing the myriad challenges climate change will present for all human and natural communities.

Other Approaches and Step-Wise Processes for Adaptation Planning

The Alliance adaptation principles provide an important approach to integrating climate change into natural resource and community planning in the Sierra. There are a number of other organizations that have developed complimentary adaptation processes and model plans for natural resources and communities. Here is a quick look at some of these processes and examples as well as where to find out more information.

ICLEI Local Governments for Sustainability:

An international association of local, regional, and national local government organizations committed to sustainable development, ICLEI has several initiatives across the world, including ICLEI USA Climate Resilient Communities. This program is designed to support local governments to prepare for the impacts of climate change through adaptation. ICLEI assists partner communities such as Keene, New Hampshire; Anchorage, Alaska; Dade-County, Florida; Homer, Alaska; and Fort Collins, CO, in identifying creative opportunities for change. ICLEI's foundation for the Climate Resilient Communities Program is a process called "The Five Milestones for Climate Adaptation."

ICLEI's Five Milestones Process for Climate Change Adaptation:

Milestone One: Conduct a Climate Resiliency Study

Milestone Two: Set Preparedness Goals

Milestone Three: Develop a Climate Preparedness Plan

Milestone Four: Publish & Implement Preparedness Plan

Milestone Five: Monitor & Reevaluate Resiliency

Further Resources from ICLEI:

ICLEI: U.S. Climate Resilient Cities Website. This website offers a brief overview of ICLEI's Climate Resilient Communities Program, information about ICLEI, and resources for getting your community and government started on climate change plans. The action center has many resources on getting started, financing, engaging your community, and more. The program recently launched its Adaptation Database and Planning Tool (ADAPT), which walks local planners and resource managers through the process of "assessing your vulnerabilities, setting resiliency goals, and developing plans that integrate into existing hazard and comprehensive planning efforts". The Sierra Business Council is partnering with ICLEI to do greenhouse gas inventories in ten Sierra Nevada counties.

http://www.icleiusa.org/programs/climate/Climate_Adaptation

Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments, Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, and Kings County, Washington: 2007. This resource helps decision makers prepare for climate change within their community. It recommends

an easy to understand step-by-step process for preparedness. There is a clear overview of climate science and reasons why decision makers should be proactive. The guidebook offers steps to take to initiate climate adaptation efforts and describes how to identify priority planning areas.

<http://www.icleiusa.org/action-center/planning/climate-adaptation-planning-resources/adaptation-guidebook>

Columbia Basin Trust (CBT):

CBT's Adaptation Initiative aims to support Columbia Basin communities, such as Kimberly and Elkford, in their efforts to increase climate change resiliency with the following six-step process. The program advocates for increasing adaptive capacity and resiliency to climate change impacts at a local, community level. As part of the initiative, the CBT provides local communities with technical resources, access to climate change experts, and consultation in developing community adaptation plans.

1. Get started by making a commitment, determining outcomes and objectives, and developing a work plan.
2. Learn about climate change through local observations and research of historical and future data/models. Use these findings to effectively communicate the science.
3. Identify priority areas for action by investigating potential impacts and utilizing existing planning documents.
4. Assess vulnerability and risk through a five-step process available at <http://cses.washington.edu/db/pdf/snoveretalgb574ch8.pdf>.
5. Develop adaptation strategies and goals to determine proper action.
6. Implement and continually monitor for new strategies. Continue community outreach.

Further Resources from the CBT:

Columbia Basin Trust Online Climate Change Adaptation Resource Kit. You can learn about the experiences and key lessons learned from the two pilot communities, Kimberly and Elkford. It offers a step-by-step menu of getting started, learning about climate change, identifying priorities, assessing vulnerability, and developing a plan to implement and monitor. There are lots of resources and case studies for review for more information.

<http://cbtadaptation.squarespace.com/>

Columbia Basin Trust Website. This is the main website of the Columbia Basin Trust and offers a comprehensive overview of CBT, the projects they have engaged in, contact information, and more.

<http://www.cbt.org/>

Chapter 5: Adaptation Strategies

This chapter focuses on specific natural resource management areas and provides ideas, examples, and opportunities for incorporating climate change adaptation strategies into existing planning processes and management. Many of the strategies and actions suggested are simple and practical. These strategies should be implemented on a large scale through existing planning processes in order to ensure a resilient and sustainable Sierra in the face of climate change. This chapter includes:

- Water & Watershed Management Strategies
- Habitat & Wildlife Management Strategies
- Forest Management Strategies
- Wildfire Management Strategies
- City & County Land Use Management Strategies

A. Water & Watershed Management Strategies

Currently, there are many different management plans to address water supply for human use, water quality, hydropower, flooding and safety, recreation, and ecosystem health. For many years, most resource management efforts operated in silos and only focused on one or a few of these water issues. However, every water management plan and strategy – whether it dictates the operation of a dam or the supplying of water to residences – operates within the larger natural watershed that is trying to balance these demands. While we break up the current resource management processes for this guide, it is important for those involved in water planning to have their plans account for impacts to all three components: water quantity, water quality, and ecosystem health.

Vulnerability of Natural Water Systems

Experts project that temperatures will increase substantially under future climate change and will further threaten already degraded watershed habitat and species. The average Sierra spring snowpack has already decreased by about 10% over the past 100 years (a reduction of 1.5 million acre-feet of water) and is predicted to decline between 25 and 40% by 2050.⁸⁵ These climate changes cast even more uncertainty on the viability of some endangered and special-status species such as salmon and steelhead trout unless we start adjusting our resource management now to address climate change. Highly variable river-stage changes can also scramble fish, other aquatic biota, and their habitat, putting additional stress on impacted native fisheries.

The average Sierra spring snowpack has already decreased by about 10% over the past 100 years (a reduction of 1.5 million acre-feet of water) and is predicted to decline between 25 and 40% by 2050.



The Sierra snowpack is projected to decline by 25-40% by 2050 due to climate change, which will have significant impacts on our communities and wildlands.

Rising temperatures and changes in precipitation are also going to cause changes in the biomass, production, and composition of terrestrial communities surrounding lakes, rivers, and wetlands. These changes may affect the supply of organic matter to freshwater systems, shading, and light, as well as the characteristics of runoff entering the system. Catastrophic fires in some regions could also affect the supply of organic matter, potentially leading to harmful increased nutrients in waterways from burned vegetation; increased sediment loading in waterways caused by increased erosion on charred upland slopes, and without the protection of trees, increased wind exposure can increase evaporation off water bodies. An increase in fire will also mean less organic matter (e.g. woody debris) enters waterways, which would normally provide nutrients and habitat for aquatic life.

Increased air temperatures will have a drying effect on many wetlands. For example, fairy shrimp, which live in ephemeral wetlands, are already losing habitat and could go extinct if warmer air temperatures reduce the wet season and evaporation eliminates their shallow vernal pool habitats.⁸⁶ In addition, increased air temperature could cause more intense flooding events which scour streambeds and harm bottom-feeding organisms, and small fish fry.⁸⁷ Warmer air temperatures will also warm waterways, resulting in decreased oxygen levels that may have negative impacts on fish eggs and larvae.

In some river systems, climate change is expected to facilitate the spread of non-native wildlife and plants. Once thermal barriers to invasion are removed, invasive species may out-compete native species. Climate change will also alter air currents, which will impact micro-climate weather conditions.

The cumulative effect will be that some rare and unique habitats needed for certain species' breeding and mating may change dramatically or disappear altogether.

Vulnerability of Built Water Systems

The United States has invested hundreds of billions of dollars in dams, reservoirs, diversion structures, and other hydrological water management strategies to manage water resources. These systems were designed and are primarily operated today assuming that future climatic and hydrologic conditions will have the same characteristics as past conditions.

Relying on past hydrological water management strategies is a mistake; climate changes will produce future hydrologic conditions for which current man-made systems are not being

operated or managed. The amount of spring runoff in the Central Sierra, whose rivers flow to the Delta, has already been declining for the past 50 years. More of that runoff is coming down in the winter.⁸⁸ Scientists are projecting that total annual streamflow into Sierra reservoirs will drop 10 to 20% before 2050 and 25 to 30% by 2100.⁸⁹ Climate change may bring more extreme events that may happen quickly and unpredictably, which could overwhelm infrastructure like dams, reservoirs, and sewer systems.

It will be important to bring 21st Century solutions to our new water challenges. We will need to re-operate our existing built systems using weather forecasting and real-time monitoring to optimize their flexibility. We should also restore the function and resiliency of our natural water systems such as mountain meadows, wetlands, floodplains, and forests so they can optimally absorb large weather events, reducing stress on our stormwater systems. Equally as important, we should reduce our reliance on man-made water systems to prepare for more droughts through far-reaching water and energy conservation and efficiency measures.

Everyone involved in water management at the local, regional, state, and/or national level needs to put water conservation and efficiency first when making decisions about our water. Increased investment in water conservation and efficiency is cost effective and provides significant benefits for water supplies and aquatic ecosystems, as well as reducing energy consumption and greenhouse gas (GHG) emissions.

Water-Wise Planning Opportunities

Water districts, local, state, and federal agencies, non-profits, and communities will play a crucial role in managing our over-allocated water resources in the face of climate change. These stakeholders have many opportunities to effect water-wise planning and integrate water issues with climate change, land use, and other pressing challenges that impact Sierra water resources. The following is a quick glance at some water plans and processes that may be underway in your region or community. Please note that this is not an exhaustive list, and that though these are specific to water, other resource management and community plans address water issues and can be found in the other sections of this chapter.

- **Integrated Regional Water Management Plan (IRWMP):** A voluntary and non-regulatory planning document informed by existing plans in a watershed or region that identifies watershed issues as well as broadly-supported goals, objectives, and projects to address those water supply, water quality, and ecosystem health issues in the region. IRWM is also a grant program of the California Department of Water Resources. This program presents an opportunity to receive funding to form a coordinated approach to meet your region's water supply, water quality, and ecosystem health objectives simultaneously. IRWMPs are an opportunity to coordinate and prioritize water management projects for your region to reduce emissions and address the impacts of climate change. IRWMPs can provide a collaborative forum for diverse stakeholders including non-profits, agencies, tribes, and local governments to address local issues, share resources, and attract funding to the region. Under the new Proposition 84 guidelines, IRWMPs must address climate change emission reduction and adaptation. For more information on IRWMPs in general and Sierra IRWMPs specifically, check out the Sierra Nevada Alliance website's IRWMP section at <http://www.sierranevadaalliance.org/programs/program.shtml?type=pgm09> or call Alliance staff at 530-542-4546.

- **Urban Water Management Plan (UWMP):** Every California urban water supplier that provides water to 3,000 or more customers, or provides over 3,000 acre-feet of water annually, should ensure the appropriate level of reliability in water service to meet the needs of various customers during normal, dry, and multiple dry years. Though climate change is not specifically called out in the Urban Water Management Planning Act, the UWMP must show reliable future water supply, water demand management measures, (i.e. water conservation), and preparation for any future water shortages. While not all urban water suppliers have an UWMP, if an urban water supplier wishes to receive state funding or drought assistance, they must have an adopted and compliant UWMP. These plans must be updated every five years.⁹⁰

The staff of the water agency/supplier with or without help of consultants develops the plan. Although an extensive public process is not currently required, the plan must be available for public review, and agencies are encouraged to seek out involvement of diverse social, cultural, and economic stakeholders within the service area. To find out more about what elements are required in UWMPs, go to: <http://www.water.ca.gov/urbanwatermanagement/>.

- **Drought Preparedness Plans:** The impacts of drought can be reduced by establishing and implementing drought management planning and water conservation measures. The state doesn't require water purveyors to create drought preparedness plans or action plans. However, as part of water code section 10611-10617, urban water supplies are required to develop Urban Water Management Plans every five years, which must look into how the water purveyor will supply water in dry years. In some cases, agencies will develop separate drought preparedness plans as a supplement or complement to the UWMP. For example, the Nevada Irrigation District adopted a revised Drought Contingency Plan in 2007, and the El Dorado Irrigation District adopted a Drought Preparedness Plan in 2008. El Dorado Irrigation District Drought Preparedness Plan outlines the actions and procedures for preparing, identifying, and responding to drought. It helps to minimize the effects of a water shortage on public health and safety, economic activity, environmental resources, and individual lifestyle. Call your local water provider to find out if they have developed a drought preparedness plan.
- **Regional Water Quality Control Basin Plans:** Water quality control plans (basin plans) provide the basis for protecting water quality in California. Basin Plans are mandated by both the Federal Clean Water Act (CWA) and the State Porter-Cologne Water Quality Act (Porter-Cologne). Each Regional Water Quality Control Board is responsible for updating their regional water quality control plan or basin plan when necessary and practical. The plan contains water quality objectives, standards and prohibitions, actions to achieve these objectives, a timeline, and how to ensure compliance with those objectives.⁹¹

The Basin Plan is a regulatory tool that is cited in Regional Water Board Orders, is used in permitting and other resource management activities, and is used by the public and other stakeholders. There are several opportunities for public involvement in Basin Plans. Each Water Quality Control Board does a triennial review (every three years) including public workshops where they hear public comments on water quality issues in the region. Each Board will respond to or investigate issues depending on their time, resources, priorities, mandates, and commitments. Amendments to the Basin Plan are also subject to a public review process. Basin plans that include the Sierra Nevada are:

Lahontan Basin Plan: http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/references.shtml

Central Valley Basin Plans: http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/

- **FERC Relicensing:** 80% of California’s hydropower dams are regulated through 30 to 50 year licenses issued for non-federal dams by the Federal Energy Regulatory Commission (FERC). Half of those facilities are expiring and are scheduled to be re-licensed in the next 15 years. The relicensing process is an opportunity for diverse stakeholders, including citizens and conservation advocates as well as regulatory agencies, to provide input on how the dam and river will be managed under the FERC license.⁹²

To find out more about the FERC Relicensing process and how to get involved, consult the comprehensive guide *Rivers of Power: A Citizen’s Guide to River Restoration through Hydropower Reform* put together by Friends of the River and the California Hydropower Reform Coalition: <http://www.hydroreform.org/sites/www.hydroreform.org/files/Rivers%20of%20Power.pdf>.

- **Watershed Plans:** A watershed management plan identifies current watershed conditions and develops a roadmap to achieve future desired watershed conditions. The plan usually includes management goals and objectives as well as implementation steps and measurements of success. Watershed plans are usually undertaken with diverse stakeholders, such as ranchers, local agencies, and non-profits who not only create the plan but continually monitor and update the plan in order to effectively achieve the its goals. Watershed plans usually look at entire drainages rather than political boundaries, and take a holistic approach to preserving and enhancing the whole watershed.

Watershed plans are not mandatory or legally binding, but they are a useful and comprehensive tool for managing, restoring, and protecting Sierra watersheds. State and federal funding have supported watershed coordinators and watershed plans, frameworks, and assessments throughout the Sierra Nevada. To find out more, check out the California Department of Conservation’s Statewide Watershed Program and Watershed Portal: <http://www.consrv.ca.gov/dlrp/wp/Pages/Index.aspx>.

Diverse stakeholders should access these opportunities and join together in every forum to incorporate the Alliance’s adaptation principles and to develop, integrate, and implement adaptation strategies in all planning efforts to protect the Sierra’s high quality water and vibrant ecosystems for Sierrans, Californians, and Nevadans.

Flood Management Opportunities to Adapt

Identify future change through modeling

- **Re-examine current operations using information from future scenarios:** Water managers should begin a systematic re-examination of engineering designs, operating rules, contingency plans, and water allocation policies under a wider range of climate conditions and extremes than have been used traditionally. For example, the standard engineering practice of designing for the worst case in the historical observational record may no longer be adequate.
- **Remap the floodplains** to identify flood potential well beyond the 100-year flood forecast. Federal Emergency Management Agency (FEMA) and the state should map the biggest reasonably foreseeable storm events possible under a range of climate change scenarios in order to provide a more realistic land use planning gauge.

Use adaptive management strategies to maintain flexibility

- **Incorporate weather forecasting into all dam operations:** Dam “rule books” need to incorporate flood forecasting into decision making so that dam operators can make “pre-flood” water releases in order to have plenty of space available for anticipated flood flows. For example, DWR will participate in a pilot project to test the H2O 2.0 Initiative – Adaptive Management for Water Storage and Flood Control Program. This program, proposed by former Lieutenant Governor Garamendi, would establish a network of monitoring stations, use satellite imagery, and generate real-time data to help dam operators make better informed water resource and flood management decisions.⁹³

Prioritize projects that will succeed under multiple scenarios

- **Set back levees to enlarge floodplain storage areas:** Spreading out flood flows across a wider area is one of our best tools to reduce the risk of catastrophic flooding for humans and our environment. Wider floodplains allow water to slow, sink, and soak into the ground, resulting in the valuable benefit of recharging aquifers. Reconnecting floodplains to their associated rivers can also provide benefits for salmon and other native aquatic life. Levee setbacks can reduce or reverse damaging channel and bank problems, helping to protect existing spawning gravels and riparian resources and increase groundwater infiltration.

Two historic and unprecedented levee setback projects on the Bear and Feather River have enlarged the floodplain, increased groundwater recharge, provided new recreational opportunities, restored native riparian habitat, and improved protection for communities flooded in 1986 and 1997 as a result of levee failures. The Bear River levee was completed in 2007 and included a 1.5 mile long setback and 639 acres of floodplain restored by River Partners. The Feather River levee setback is almost complete it will be a 6-mile long setback that expands the floodplain by 1,500 acres and provides habitat for threatened and endangered species like the Swainson’s hawk.⁹⁴

- **Explore opportunities to optimize existing dam operations:** Currently, many of California’s dams are used for both hydropower and flood protection. This is possible because the operations for each use happen at different times of the year based on historic precipitation patterns. However, with climate change, these two management periods may increasingly overlap, forcing water managers to choose to manage for flood protection or hydropower rather than both. Water and utility managers should consider other flood protection methods such as levee setbacks and connecting rivers to their floodplains to attenuate flooding. This would reduce pressure to use these dams for flood protection only, and allow more flexibility to manage them for water supply and hydropower generation.
- **Evaluate, develop, and implement floodplain restoration and other non-structural flood management options:** Flood management options include water conservation and efficiency measures, levee setbacks, meadow restoration, floodplain inundation, groundwater recharge, storm water management, improved management of floodways below big dams, and prohibition of new development in floodplains. Protecting floodplains, restoring wetlands, and adopting natural storm water management techniques will be important steps toward safeguarding communities and our environment.

The Deer Creek Floodplain Restoration Project, sponsored by American Rivers and other diverse partners including Friends of Deer Creek, Nevada County Land Trust, and the Bureau of Land Management, is an attempt to restore healthy function to the Deer Creek floodplain using restoration techniques. The project involves removing a berm so the creek can flow into the floodplain and promoting groundwater recharge and increased stream flows during drier months. The project will remove non-native species while planting native vegetation along the riparian corridor to promote carbon sequestration and water filtration and increase critical habitat. There is also an education component where students participate in restoration work as well as on-site educational activities in wetland ecology and restoration.⁹⁵ This is a great example of a floodplain restoration project that achieves multiple goals and utilizes the expertise and resources of diverse partners.

- **Ensure land use plans, including General Plans, will not approve new non-agricultural parcel maps or subdivision maps within 200-year flood zones as mapped by FEMA.** This will reduce reliance on dams and levees to protect communities from flooding as well as save lives, property, and money.

Integrate and coordinate local efforts

- **Participate in local resource management planning:** Local resource management planning including IRWM plans, General Plans, and flood management plans should work to ensure flood issues are being addressed within the context of climate change.

Dam Relicensing Opportunities to Adapt

Identify possible future changes through modeling

- **Develop and request temperature studies in the relicensing processes:** In most Sierra rivers, studies will be needed to examine new management strategies protecting or maintaining coldwater fisheries that depend upon management of the coldwater pool in reservoirs and releases from hydropower dams. Accordingly, temperature studies in the channel below the dams as well as temperature studies in the reservoirs themselves are very important. More specifically, it is important to study river temperatures in the thalweg (the center of the river where it is deeper and colder) as well as in the margin of the river (where the water is shallow and warmer). The difference between thalweg and margin temperatures can inform the development of flow releases that can support both fish that thrive in colder water and amphibians that thrive in the warmer margin waters.
- **Work with the relicensing participants to develop a water temperature model that can analyze alternative flow scenarios and their resulting temperatures:** Consider inflows from other hydropower projects and whether they will change under future license conditions.

Use adaptive management strategies to maintain flexibility

- **Include adaptive management plans for the new license:** There can be multiple adaptive management steps and/or plans linked to monitoring, post-licensing studies, construction of the project, or mitigation phases. Adaptive management conditions need to have pre-defined testable hypotheses, protocols, metrics, and a defined range of outcomes or changes. The adaptive management steps may range from more study to re-negotiating license terms and submitting them to FERC. For example, adaptive management license conditions can address potential unforeseen temperature increases. The Upper American River Project License includes an adaptive management condition that says if temperature exceeds a certain threshold, the licensee must install temperature monitoring devices and modify flow regimes to meet temperature targets. Data from temperature gauges in sensitive river reaches can inform modification of the magnitude and timing of flows released to meet the temperature targets, especially for protecting target amphibian and fish species.
- **Set specific standards in new licenses:** Make sure license conditions contain specific standards the licensee must meet independent of external pressures. Be specific about compliance points and the associated temperature thresholds for each river reach affected by the hydropower project. License conditions should not describe limited operational changes, such as “the licensee will increase instream flows by 20 cfs from historic operations in order to keep the stream at 16° C.” Under climate change scenarios, dam operators might have to increase the instream flow even further in order to keep the stream at 16° C.

- **Include “conferencing” with relicensing participants as a first response to emergencies and in extreme dry years or consecutive dry years:** A license can include terms for “conference years”, which can require that in the event of an emergency that may require deviating from the license conditions, the licensee must convene relicensing participants and attempt to arrive at a collaborative agreement for next steps. These plans would then be submitted to FERC on behalf of the whole conference. This condition essentially allows relicensing participants to speak on behalf of resource protection in the event of an emergency that might justify to FERC violation of license conditions.
- **Include “re-openers” for very specific issues that arise after the scheduled relicensing:** Reopening a FERC license refers to a specific regulatory process, which is administered at the discretion of FERC. In a reopener, FERC might reopen the whole license or just part of it. Generally, adaptive management measures with pre-defined triggers for pre-defined actions in the license are preferable to reopeners. This is because in a reopener the decision space and variables might not be clearly defined, which can adversely affect the negotiation. Therefore, it is not recommended to defer decision-making on resource issues being negotiated in the relicensing to a reopener. Some resource agencies, such as National Marine Fisheries Service (NMFS), can include reopener clauses in their prescriptions for the new license. An appropriate use of a reopener could be for FERC to reopen a license if NMFS reintroduces anadromous fish into project-affected river reaches.

Monitor and track changes in weather, hydrology, ecosystems, and communities

- **Establish monitoring plans for the new license:** Monitoring should study the results of implementation of the new license conditions and flows. Monitoring plans should track the target species and their health under the new operations. For example, “Are Foothill Yellow Legged Frogs’ development stages changing or staying the same as when studied under the relicensing process? If the development stages are changing, what is the effect of the new operations on their health and abundance?”

Integrate and coordinate local efforts

- **Participate in Integrated Regional Water Management Planning (IRWMP):** An IRWMP can provide another collaborative forum for the stakeholders involved in a hydropower relicensing. This alternative forum provides a space to develop and implement agreements and projects that may not come under the purview of relicensing. IRWMPs may also provide relevant information or solutions to a relicensing proceeding.

Watershed & Fisheries Management Opportunities to Adapt

Identify possible future changes through modeling

- **Model your watershed:** Hydrologic and planning models can help inform numerous important questions about our watersheds. A model is a re-creation of a natural system or object that attempts to re-create the key components and interactions of the physical system. Changing values and assumptions in the model allows the user to simulate different conditions in the real world. Modeling your watershed can allow you to better

understand how rising temperatures, invasive species, predators, disease, variability in flows, sediment dynamics, fish life cycle needs, and other factors might interact and change under various climate change scenarios, enabling resource managers and others to better prepare and protect Sierra rivers. It is important for users of these models, however, to recognize the limitations of existing data, which inform the model and can restrict its utility.

- **Utilize existing models in your watershed:** If the scale of your project or planning process is small or constrained by a small budget, using existing models of your watershed can help you get started in planning for a range of different future scenarios. Also check with nearby universities and state agencies to learn what downscaled climate models may already exist that include your watershed.

Use adaptive management strategies to maintain flexibility

- **Preserve habitat connectivity to allow species access to migration corridors and cooler temperatures:** Connectivity is important not only between different freshwater habitats (i.e. rivers, lakes, and wetlands), but also along the length of rivers, groundwater sources, and other freshwater habitats. Headwaters and tributaries should be protected to provide cooling temperatures to the main stem rivers. Protecting tree canopies and vegetative cover that shade the margins of water bodies can also help keep temperatures down. Planners should consider protecting areas where species are likely to migrate to find their optimal temperatures and habitat, although those areas, under current conditions, might not be a high priority for wildlife protection.

For example, the Southern Sierra Partnership (Audubon California, Sequoia Riverlands Trust, Sierra Business Council, and The Nature Conservancy) developed a Regional Conservation Design, “a spatial vision that integrates conservation goals, threat projections, and climate change responses to identify areas of the landscape that offer the best opportunities for sustaining biodiversity and ecosystem services.”⁹⁶ In developing the Regional Conservation Design and strategic recommendations to address climate change adaptation, the partnership highlighted the importance of connectivity across habitats, elevation, and other gradients, specifically protecting and restoring riparian corridor connectivity, as important adaptation strategies and actions.⁹⁷ To find out more about the Regional Conservation Design, go to: <http://conserveonline.org/workspaces/climateadaptation/documents/southern-sierra-partnership-ca-0>.

Promote the resiliency of existing ecosystems, and minimize stressors

- **Protect physical features rather than just individual species:** Protecting flow patterns, water quality, and water quantity will go a long way towards protecting biodiversity in freshwater habitats. Conservation efforts that focus solely on preserving particular species or groups of species without considering wider physical features of the system may fail. But don't let this stop you from forming campaigns around publicly-known species that attract funding and attention for restoration of the larger ecosystem!
- **Manage entire watersheds not just pieces:** Managing entire watersheds in addition to protecting key aquatic elements or habitat patches will become increasingly important as the effects of climate change intensify and are compounded by other stressors such as development. The Feather River Coordinated Resource Management Group (CRM)

provides a positive example of watershed-based management of the Upper Feather River watershed of the Sierra Nevada. The CRM has been instrumental in coordinating resource management and planning in the region, educating the public, restoring meadows, wetlands, and streams, as well as contributing to the field of restoration science. To find out more about the Feather River CRM's efforts to restore the Upper Feather River Watershed, go to www.feather-river-crm.org.

Prioritize projects that will succeed under multiple scenarios

- **Reduce human water demand, and change water use behavior:** Climate change adaptation strategies that provide incentives for conserving water, increase water efficiency standards for irrigation, industry, commercial, and residential uses, and that maximize our use of regional rather than distant water sources should be prioritized. South Tahoe Public Utility District has a water conservation program working to educate the public and reduce demand by offering rebates for water efficient clothes washers, implementing a turf buy-back program for lawns, and working with hotel and motel clean linen programs, as well as restaurant drinking water programs. Efforts like these can reduce demand on Sierra watershed and groundwater systems, particularly if the managing agency commits water allocations for ecosystem needs. Opportunities like that of American Rivers to establish a Sierra Water Trust model should be explored to ensure water is allocated for environmental use.

Integrate and coordinate local efforts

- **Join Integrated Regional Water Management Planning (IRWMP) to work with others to protect entire watersheds and provide a basis for long-term conservation:** In most Sierra IRWMPs, all the stakeholders in a watershed (e.g. local community members, county representatives, water and fishery resource managers, conservationists, water agencies, tribes, and businesses) can jointly assess their objectives, prioritize projects, and develop adaptive management strategies. IRWMPs can also provide an opportunity to identify and integrate existing water plans and projects in the region, such as Urban Water Management Plans, Drought Preparedness Plans, and Watershed Plans. If all the stakeholders in the region manage a watershed, there will be a better chance of protecting areas that are particularly vulnerable to climate change. IRWMPs, coordinated with other resource plans, can also minimize the impacts of land use practices and other human stresses that can exacerbate the negative impacts of climate change. The collaborative IRWMP groups are ideal forums for finding opportunities for implementing climate smart water management.

Water Supply Opportunities to Adapt

Identify possible future changes through modeling

- **Model your water system and conduct risk analysis to determine future water demand versus water supply under various climatic conditions:** For example, in preparing their Drought Preparedness Plan, El Dorado Irrigation District (EID) recognized the importance of addressing climate change impacts and identifying potential responses in preparing for, identifying, and responding to a drought. Within the plan there is a

substantial section devoted to climate change, including an explicit recognition of “the importance and potential implications of climate change to EID and its customers.”

EID employed the services of the Stockholm Environmental Institute (SEI) to re-create EID’s water system and watershed in SEI’s Watershed Evaluation and Planning (WEAP) model. In developing the model, SEI sought to build upon the drought preparedness work that EID had already done using their Shared Vision Model (SVM) by adding the variable of climate change. While the SVM uses the hydrology from the historic 1922-2003 period as input, with the addition of a “second” 1977 year to the 1976-77 drought to simulate climate change, the WEAP model uses a range of possible scenarios about future climate (the 23 General Circulation Models) up until 2030 and the associated hydrologic regimes as model input.

It is important to keep in mind that while these models have their uses, they are not crystal balls and will not predict the future. These models help planners forecast and plan for a range of hydrologic conditions under a variety of climate scenarios. In the case of EID, these tools indicated that under various climate change scenarios EID would not be able to meet water demand, allowing them to start planning and implementing climate smart, non-structural solutions like improving water efficiency now in order to meet future water demand under various climate scenarios.⁹⁸

- **Consider climate change when making commitments about future water deliveries:** Water agencies and irrigation districts should avoid promising increased water deliveries based solely on current hydrology, without taking future climate conditions into account. Hydropower utilities should also plan ahead to meet their minimum requirements for FERC and other federal and state agencies under future climate change scenarios in which the water regime will change.

Use adaptive management strategies to maintain flexibility

- **Encourage greater water efficiencies by retrofitting existing water infrastructure:** In the Sierra, one opportunity for improving efficiency is identifying historic open dirt ditches that don’t possess important historical, recreational, or cultural value, and lining and encasing some sections of those ditches. With a grant from the Sierra Nevada Conservancy, the Tuolumne Utilities District (TUD) is in the process of creating a Best Management Practice for evaluating ditches for these different values. TUD is identifying strategies such as conservation easements, outreach programs, ditch trail standards, and capital improvements to conserve water and preserve other values the ditches provide to the community and the environment. In that process they will identify those areas without cultural, recreational, or ecological importance and implement strategies, including lining, to improve water quality and reliability and reduce water loss. To find out more, check out their SNC grant proposal at <http://www.sierranevada.ca.gov/docs/SNC070135sum.pdf>.
- **Implement efficiency measures to replace wasteful forms of agricultural irrigation:** The Pacific Institute’s many resources and publications show that water-efficient drip irrigation systems can significantly reduce the water required for many growers, yet 60% of California’s irrigated lands remain flood irrigated. Besides saving water (and in some cases energy use), efficiency measures can have other benefits including improving water quality, reducing pressure on groundwater sources, and restoring water to

watersheds. The up-front costs of technologies like drip irrigation can be significant, but agencies and programs like the Natural Resources Conservation Service (NRCS) and the University of California Cooperative Extension (UCCE) not only provide expert assistance, but they can also connect farmers to a variety of federal, state, and local grant and loan programs that support improving agricultural water efficiency.⁹⁹

- **Promote Sierra-friendly landscaping to reduce water use:** With climate change likely to increase evaporation and transpiration rates in planted landscapes, a lawn or landscape could consume more water in the future than it consumes today. The Sierra Nevada Alliance’s *Sierra Nevada Yard and Garden Guide* (which can be found at www.sierranevadaalliance.org) is designed to be a companion in the creation and maintenance of beautiful, resource-efficient, sustainable, and cost effective landscapes. This first-of-its-kind resource helps Sierra homeowners and others create attractive yards and landscaping that guards against wildfire, needs little maintenance, flourishes with native and adapted plants, exists in harmony with wildlife, and protects and conserves Sierra water. This guide shares practical, easy to follow steps, tips, and how-to’s to meet your needs while being Sierra friendly.
- **Dedicate water for in-stream flows:** Using the model for water trusts developed in Washington and Oregon, the Sierra can work with water efficiency programs and willing landowners and water rights holders to ensure that a percentage of water saved gets dedicated in the short-term or in perpetuity to in-stream flows – not for increased development opportunities. The Scott River Water Trust obtained its first water leases in 2007, making it the first active water trust in California. The purpose of the water trust is to improve streamflow for fish habitat throughout the Scott River and its tributaries through leases with willing water rights holders, who then leave the water in stream for a week, month, or longer, depending on the lease, rather than using it.¹⁰⁰ For more information on water trusts, “Getting our Feet Wet: An Introduction to Water Trusts”, is a helpful and informative resource available online at the following website: http://www.law.harvard.edu/students/orgs/elr/vol28_2/king.pdf.

Monitor and track changes in weather, hydrology, ecosystems, and communities

- **Install water meters:** In 2004, the California Legislature passed AB 2572 requiring urban water suppliers (3,000 or more hookups) to install water meters on all municipal and industrial water service connections by 2025.¹⁰¹ Urban water suppliers in the Sierra should be working now to meet this requirement in order to monitor how much water is being used. They should award users who are conserving water by charging ratepayers based on consumption, as well as implement and measure the effectiveness of water conservation strategies that are now required. For more information see the strategy below entitled “Develop and implement water conservation and efficiency strategies for rural communities and agricultural lands”.
- **Conduct studies and monitor groundwater in order to identify vulnerabilities and implement best management practices:** Little information is available on how climate change might affect groundwater aquifer characteristics, including quality, recharge rates, and flow dynamics. In fact, the Sierra’s water stakeholders and managers still need to understand the basic function and recharge of our fractured rock aquifers as well as understand the connection between surface water and groundwater. Climate change further highlights the great need for this basic planning information, which

should inform land use decisions to protect groundwater recharge areas as well as manage well and groundwater pumping so they don't cumulatively dewater the base flow of rivers or overdraft groundwater supplies.

Starting systematic monitoring will help managers identify trends and develop best management practices and emergency preparedness plans in the face of climate change. Furthermore, in places like Fresno County, developers only have to prove water is available for each parcel, not each well and they do not have to prove water will be available over a longer period of time. Getting groundwater and well monitoring systems in place and better understanding our base resource will be necessary to prevent further unsustainable new development that jeopardizes water availability for existing development.

Prioritize projects that will succeed under multiple scenarios

- **Invest in new water-wise technologies to improve water reliability for human consumption and our environment:** Traditional and alternative water strategies can play a role in addressing changes in both supply and demand of water caused by climate change and the resulting variability in water availability. Options to be considered include water recycling, graywater use, rainwater harvesting, storm water capture, and wastewater reclamation and reuse. Please refer to the Sierra Nevada Alliance's publication *Planning for Water Wise Development in the Sierra* at www.sierranevadaalliance.org for more on these new technologies and their potential applications in Sierra communities.
- **Develop and implement water conservation and efficiency strategies for rural communities and agricultural lands:** The Pacific Institute is a non-profit organization that conducts research, publishes reports, recommends solutions, and works with decision-makers, advocacy groups, and the public to change water policy. According to their research, "improving efficiency and conservation is often the most economically, politically, and environmentally responsible way to increase supply and save for the future."¹⁰² By assisting Sierra rural and agricultural communities to use less and to use water more efficiently, communities are better prepared to face future climate change scenarios in which there might be a dramatic decrease in the amount of water available. Estimates from the Pacific Institute indicate that one million acre feet of water could be cost-effectively saved in the near term, and six to eight million acre-feet by 2020.¹⁰³ For California agriculture, Pacific Institute estimates that 4.5 to 6 million acre-feet of water could be saved every year through more efficient irrigation and best management practices.¹⁰⁴

Increasing water efficiency at the local level is now a state mandate and priority. In November 2009, the California Legislature passed Senate Bill x7-7 which requires all urban water suppliers that provide over 3,000 acre-feet of water annually, or serve more than 3,000 or more connections, to reduce their per capita urban water use by 20% by December 31, 2020. In addition, urban water suppliers must set a water use target and an interim water use target by July 1, 2011 and include baseline information in their urban water management plan for daily per capita water use and compliance plans for daily per capita water use.

In 2004, the California Legislature passed AB2572 requiring urban water suppliers (3,000 or more hookups) to install water meters on all municipal and industrial water service connections by 2025.

The bill also requires measures to be taken to ensure agricultural water conservation. Agricultural water suppliers must prepare and adopt agricultural water management plans by December 31, 2012, then update these plans in 2015, and update them every five years thereafter. They must also adopt a pricing structure for water customers based on the quantity delivered, implement water efficiency practices, and measure the volume of water they are supplying to their customers.¹⁰⁵

If an urban or agricultural water supplier does not meet these requirements, they become ineligible for state water grants or loans. To find out how your local water agency is addressing these requirements, check out their website or give them a call. For more information on water conservation and efficiency strategies, go to:

Pacific Institute

<http://www.pacinst.org/>

California Urban Water Conservation Council

<http://www.cuwcc.org/>

Department of Water Resources

<http://www.water.ca.gov/wateruseefficiency/sb7/>

In November 2009, the California Legislature passed Senate Bill x7-7, which requires all urban water suppliers to reduce their per capita urban water use by 20% by December 31, 2020.

- **Bank water in naturally occurring “infrastructure” as provided by wider levee setbacks and restored meadows and wetlands:** As climate change shifts precipitation patterns in the Sierra, and as we see more rain on snow events, restored Sierra meadows and wetlands can play an important role in reducing flood risk, improving water reliability, and maintaining late summer flows. The California Water Plan estimates that 50,000 to 500,000 acre-feet per year could be stored and released by restored Sierra meadows.¹⁰⁶ The National Fish and Wildlife Foundation’s Sierra Nevada Meadow Restoration Initiative focuses a grant program on meadow restoration and science as well as building the capacity of groups to restore meadows. To find out more visit the website of the *Sierra Nevada Meadow Restoration Business Plan*: http://www.nfwf.org/Content/ContentFolders/NationalFishandWildlifeFoundation/GrantPrograms/Keystones/WildlifeandHabitat/Sierra_Meadow_Restoration_business_plan.pdf.
- **Promote conservation pricing:** Water agencies and irrigation districts should join the California Urban Water Conservation Council and adopt their Conservation Pricing policies. In 1991, Irvine Ranch Water District (IRWD) replaced its flat rate-per-unit charge with an allocation-based conservation rate structure. This structure provides a water allocation for customers based on their needs. Each customer is billed a basic charge per water unit within their allocation based on their metered water use. If they go beyond their allocation, conservation charges are added for the excess water. In addition to charges based on volume, other fixed charges may be included in the bill to cover other fixed costs incurred in providing the service.¹⁰⁷ The success of this rate structure for conservation and for customers’ wallets, as well as IRWD’s outreach programs can be seen by the numbers:
 - ◆ Average landscape water use decreased 61%, from 4.2 acre-feet per acre per year to 1.9 acre-feet per acre per year between 1992 and 2005.¹⁰⁸
 - ◆ IRWD has the second lowest water rates in Orange County.¹⁰⁹
 - ◆ IRWD customers use 52% less water per day on average than customers served by other Orange County water suppliers.¹¹⁰



Red Clover Creek before restoration in 2006 (above) and after restoration in 2008 (right). Creek and meadow restoration can improve water quality and increase natural water storage while helping reduce peak flooding downstream.



Integrate and coordinate local efforts

- **Participate in collaborative Integrated Regional Water Management Planning (IRWMPs):** IRWMPs provide an opportunity to bring land use planners, forestry experts, environmental justice representatives, conservation leaders, tribes, businesses, and other key stakeholders who use and manage water and the watershed together to coordinate water management. The IRWM forum is the perfect means to sharing resources among agencies (like modeling for the region), sharing expertise, and preventing the development of solutions that transfer problems to other issue arenas. For more on IRWMPs, see page 61.
- **Improve coordination between land use planning and water agencies:** Water agencies and local governments share the burden of ensuring water delivery and reliability of local water supplies yet often they do not coordinate until the environmental review process to verify water supplies for certain development projects. Strategies for improving coordination to sustainably manage water in a region include: integrating water data into land use planning documents; supporting IRWM plans and projects; and integrating land use data into water planning. Please refer to the Sierra Nevada Alliance's publication *Planning for Water Wise Development in the Sierra* at www.sierranevadaalliance.org for more information.

The Calaveras County General Plan Water Element is an example of one county taking a step further to coordinate water and land use planning. Water elements are not required within California County General Plans; however, they can help improve integration of water and land use planning, promote and support smart growth policies, increase water use efficiency, and improve water planning. For Calaveras County, the

water element seemed the ideal avenue to address important water and land use issues in the county such as well and septic system failures, sprawling development, and lack of standardized policies.¹¹¹ To see the county's first step toward integrating and addressing climate change, water, and land use issues, go to [http://www.ccwd.org/documents/Water_Element/Calaveras_WE_Draft_PolicyDocument_2009%20Feb-\(1\)_complete.pdf](http://www.ccwd.org/documents/Water_Element/Calaveras_WE_Draft_PolicyDocument_2009%20Feb-(1)_complete.pdf).

- **Change county building codes, local ordinances and General Plans to conserve water and use water more efficiently:** Counties can have an effect on water supply and conservation through changes in building codes and local ordinances as well as General Plans (see more in the City and County Land Use Planning Section in the Sierra Nevada Alliance's publication *Planning for Water Wise Development in the Sierra*).

On January 1, 2011, the new California Green Building Code, the first in the nation, took effect. The code includes setting water conservation and efficiency standards for indoor and outdoor water use that cities and counties will have to adopt for new residential and non-residential buildings. The Code also encourages more stringent voluntary measures cities and counties can take to further reduce GHG emissions, conserve water, and protect natural resources. To read the entire code, go to: http://www.documents.dgs.ca.gov/bsc/CALGreen/2010_CA_Green_Bldg.pdf.

On January 1, 2011, the new California Green Building Code, the first in the nation, took effect.

- **Review the legal allocation of water rights to address inequities and environmental justice concerns:** The risks of climate change make such a review even more urgent. IRWMPs provide an opportunity to address disadvantaged community members' needs in the planning and implementation processes. Proposition 84 grant money from the California Department of Water Resources IRWM program is available to meaningfully engage disadvantaged communities, identify their water issues, and challenges, and implement appropriate water projects. To find out more, check out: <http://www.water.ca.gov/irwm/index.cfm>.

In addition to funding opportunities, organizations like Environmental Justice Coalition for Water have worked as advocates for water inequities in under represented populations such as low-income and minorities. To learn more about their work and their recommendations on how to address these issues check out their website: at <http://www.ejcw.org/index.html>.

B. Wildlife and Habitat Protection Strategies

The Sierra Nevada supports a wide range of plant and animal life, including 3,500 native plant species and 400 species of terrestrial wildlife.¹¹² While it comprises only a fifth of the total land area of California, half of the native plant species in the state occur within the range. In addition, more than 400 plant species are endemic to the Sierra Nevada and many of these are listed as threatened or have other special conservation status. There are also 30 native California fish species and 321 types of insects that depend on Sierra headwaters.

The Sierra's flora and fauna have been altered by factors such as roads, fire, and development, with many new developments being planned for the future. Climate change is exacerbating these existing stressors and bringing new challenges for wildlife and habitat protection. The Sierra's biodiversity and wide range of ecotones is directly related to climate conditions influenced by elevation, making it that much more susceptible to significant change as a result of climate change. Some ecotones are shifting upward and northward in the Sierra.



"Autumn Colors" ©ElizabethCarmel.com

Mono Lake in the Eastern Sierra is an important migration stop for many birds and is a beloved destination for birders.

Shifts in migratory patterns due to climate change will have enormous implications for alpine species. Scientists recently re-surveyed the ranges of mammals, birds, amphibians, and reptiles that were documented by Joseph Grinnell between 1914 and 1920 on a transect running through Yosemite National Park. The project found that climate change, among other factors, has affected mammals in the following ways:

- Seven out of 50 species showed significant range expansions. Five species moved upwards in elevation while two expanded their ranges downhill.
- Seventeen out of 50 species' ranges shrank, with nine species experiencing contractions due to an upward reduction of their lower elevation range. Three species experienced downhill shifts in the upper elevation limits of their range. Four species experienced contractions of their ranges at both upper and lower elevation limits.
- More mammals' ranges shrank than expanded at a rate of 2.5 to 1. The range reductions were especially significant for higher elevation species.
- Two species, the Shadow chipmunk (*Tamias senex*) and the Bushy-tailed wood rat (*Neotoma cinera*) were abundant during the historic survey; however, the modern survey had limited success in finding either species across their ranges.¹¹³

A number of species will eventually encounter the tops of mountains as they continue to travel upward in search of suitable habitat, conditions, and resources. With nowhere left for wingless species to migrate these species will be forced to either adapt at unprecedented rates or will become endangered and potentially extinct.

As climate change continues to alter the integrity of habitats and ecosystems, it will be more important than ever before to provide species with migratory corridors between different and changing habitats. Species will find it difficult or impossible to migrate out of unsuitable territory without protected wildlife corridors ranging in size, habitat, and distance. This issue will be exacerbated by a growing and encroaching human population, sprawling development, increasingly fragmented landscapes, and more frequent and severe fire seasons. Even if species do migrate to suitable territory successfully, they may arrive only to find that insufficient habitat has been protected to sustain a viable population.

Sierra riparian corridors will likely be important refugia and migration corridors for species, because they act as a water supply during the dry, summer months and provide cooler habitat temperatures for critically endangered species. These riparian areas have already suffered increased habitat degradation and pollution from mining, logging, inappropriate development, and population growth. Climate change may have crippling impacts on these aquatic habitats and species if drought becomes increasingly more prevalent and water demands increase downstream.

Native species will face competition from invasive species that are no longer contained by historic climate conditions. Invasive species have the potential to decimate and completely alter ecosystem composition. They threaten not only the unique species of the Sierra, but the entire Sierra ecoregion as a whole.

Sierra stakeholders must work to promote policies that reduce greenhouse gases, provide benefits and protection to wildlife, and build robust, resilient ecosystem networks within the Sierra. California's wildlife agencies should strategize with research institutions, non-profit organizations, and universities to address the best management options for California's wildlife.¹¹⁴

There are several planning processes and other mechanisms that can be utilized to protect Sierra wildlife and habitat in the face of climate change:

- **Habitat Conservation Plans (HCPs)** are developed in concert with the U.S. Fish and Wildlife Service to create mitigation for incidental take of federally-listed endangered and threatened species by non-federal parties across a region or county, rather than developing mitigation requirements on a project by project basis, which is costly and time intensive for all parties involved. **Natural Community Conservation Plans (NCCPs)** are developed to conserve natural communities at the ecosystem level while allowing compatible land uses. These plans are developed under the federal Endangered Species Act and California's Natural Community Conservation Planning Program Act, respectively. While separate plans with different regulatory requirements, these legally binding plans are often developed together for a county or region under a single process. A HCP/NCCP allows local governments to coordinate their natural resource planning at the regional scale while determining where and how growth should occur. A streamlined permitting process for developers clearly defines allowable types of and locations for growth, reducing conflict among various interests.¹¹⁵ Another important component of the NCCP is that they require fine scale vegetation mapping according to

state standards. This mapping would be a vital tool for analyzing habitat impacts over time and would establish a baseline for how conditions are changing. Most of the Sierra lacks such mapping. Placer County is currently the only Sierra Nevada county with a proposed county-wide HCP/NCCP.

- **Conservation easements** are used by land trusts, local governments, or other entities to purchase the development rights for a piece of property with habitat or other conservation value to keep it permanently undeveloped, while allowing the private landowner to retain ownership of the land and use it in a manner consistent with the easement (such as agriculture or recreation).
- **The California Land Conservation Act of 1965**, better known as the Williamson Act, is a state law that enables local governments in California to enter into contracts with private landowners to preserve private land as agricultural land or other related open space. In return for limiting development on their land, landowners receive lower property tax assessments. Contracts must be no shorter than ten years, and they are estimated to save landowners from 20% to 75% in property taxes each year.
- **Federal and state protected areas** can provide varying levels of habitat and wildlife protection. These designations include state and federal wilderness areas, Wilderness Study Areas (WSAs), roadless areas, Wild and Scenic Rivers (WSRs), Research Natural Areas (RNAs), Areas of Critical Environmental Concern (ACECs), critical habitat, wildlife refuges, ecological reserves, state and national parks, and national monuments, among others. These protected areas, most of which are already found throughout the Sierra, differ in their purpose, ability to protect wildlife and habitat, and level of permanence. Some are easier to establish than others, though all are highly political. For example, a group wishing to protect a stretch of federal or state administered river and its immediate surrounding habitat can organize a campaign for federal WSR designation, which occurs through an Act of Congress. Likewise, the President can designate a National Monument to protect an area on federal lands with objects of historic or scientific interest, including rare habitat or other unique ecological features, through presidential proclamation without the approval of Congress.
- **Landscape Conservation Cooperatives (LCCs)** are management-science partnerships that inform integrated resource management actions addressing climate change and other stressors within and across landscapes. While some LCCs had already been formed, the LCC program was established by Secretary of the Interior Ken Salazar through Secretarial Order in February 2010 to focus on on-the-ground strategic conservation efforts at the landscape level. These cooperatives work to apply science and facilitate communication among involved agencies and organizations on a wide range of issues including climate change, wildlife, and invasive species across jurisdictional lines. Two LCCs have formed that include the Sierra Nevada: the California LCC and the Great Basin LCC. The California LCC covers the west slope of the Sierra, as well as the Central Valley, Bay-Delta, and central and southern coasts. It is coordinated by the U.S. Fish and Wildlife Service and partners include federal and state resource management agencies as well as universities and non-profit organizations. The Great Basin LCC covers the east slope of the Sierra and the rest of the Great Basin region. It is coordinated by the Bureau of Land Management with assistance from the U.S. Fish and Wildlife Service, and potential partners include federal and state agencies, tribes, universities, non-profit

organizations, and private landowners. For more information and to get involved with either of these LCCs, visit their websites:

California LCC:

<http://californialcc.org/>

Great Basin LCC:

http://www.blm.gov/wo/st/en/prog/more/Great_Basin_LCC.html

Land managers, planners, policymakers, private landowners, and conservation groups still have time to devise and implement adaptation actions, such as the following strategies, to protect and conserve the Sierra's ecosystem from new threats posed by climate change. These strategies can be incorporated into the processes and mechanisms described above or can be implemented independently.

Identify possible future changes through modeling

- **Predict where critical habitat will be in the future and work now to protect it:** Use predictive models to identify refuges and places where species will migrate. Then create conservation systems that allow species to move. Most current conservation efforts focus on preserving particular species and ecosystems, which are fixed in one geographic area. However, when a species starts to migrate due to climate change, we need to be protecting not only where it is today, but where it will be in the future, and connections that allow it to get it from point A to point B. The use of conservation easements may be a useful tool for protecting these new migration corridors.

For example, as part of their “Framework for Cooperative Conservation and Climate Adaptation in the Southern Sierra Nevada and Tehachapi Mountains,” the Southern Sierra Partnership used past and present trends and future climate predictions to project future habitat for numerous native oak species in their study area. By taking into account these and other predicted effects of climate change, as well as the current distribution of conservation targets and threats, they created a Regional Conservation Design that prioritizes sites for habitat conservation.

Monitor and track changes in weather, hydrology, ecosystems, and communities

- **Identify and monitor what needs to be protected:** It is vital to quickly identify and monitor which species, species assemblages, habitats, ecological processes, or landscapes will be particularly sensitive to climate change and in need of conservation and protection. It is also important to recognize which will be most resilient. Particular attention needs to be paid to keystone species such as pollinators or seeders. Wilderness and roadless areas should remain undeveloped so these native-dominated communities can serve as models to help us understand how unaltered areas respond to climate change.

Use adaptive management strategies to maintain flexibility

- **Protect habitat of varying size and type** in order to provide adequate space and resources to maintain viable populations of many different species.

- **Encourage connecting ranges:** Improving connectivity between habitats and creating wildlife corridors will facilitate migrations, range shifts, and protection of wildlife populations for future generations.
- **Maintain or mimic natural fire regimes:** (See *Section C: Forestry Management Strategies*)

Promote resiliency of existing ecosystems, and minimize stressors

- **Promote increased habitat diversity:** Diverse communities are better able to withstand threats and disturbances. Diverse habitats within an ecosystem provide varied protection for species depending on future climate scenarios. A habitat that might not be utilized today may be valuable depending on future conditions.
- **Protect and increase plant and animal diversity** to further provide relief from potentially detrimental events such as insect breakouts. Diverse plant communities and landscapes are able to provide natural barriers against massive insect or disease spreads.
- **Prevent and minimize road impacts on native habitats:** Protection of roadless areas and relatively intact habitats should be a priority, as habitats distant from roads and human disturbance often serve as refuges for native species. Fragmentation of ecosystems by roads contributes to reduction in biodiversity and the spread of invasive species. Avoid road construction in roadless or vulnerable habitats, and avoid creating corridors for Off Road Vehicles (OHV) use in these areas. Road maintenance should be timed to avoid the spread of invasive species. Using native species in soil stabilization and re-vegetation operations is effective in minimizing impacts. Ensure that road-fill used in road maintenance operations is not contaminated with weed seeds.
- **Prevent and control the spread of invasive weeds and other species:** Aggressive, prevention-oriented, and adaptive approaches should be used to control the spread of invasive species before lands become invaded. More knowledge is needed regarding pathways of introduction and dispersal, including the roles (and effects) of logging, roads, trails, human visitation, cars, heavy equipment, pack animals, and livestock. This knowledge would aid in understanding where to look for incipient outbreaks and identifying vegetation communities that will be most vulnerable to full-scale invasion. This will require persistent monitoring, rapid eradication of incipient infestations, and coordination with neighboring landowners to prevent adjacent lands from providing seed sources for re-colonization. Land managers need to perform systematic surveys of distribution and abundance of the main problem invaders, with coordination for monitoring and control efforts at a regional scale.
- **Protect open space and prevent sprawling development:** (See *Section E: City and County Land Use Planning Strategies*)

Integrate and coordinate local efforts

- **Participate in regional efforts to protect wildlife habitat and connectivity (such as the development of a Habitat Conservation Plan or the establishment of a Landscape Conservation Cooperative; see page 78 for more information):** These efforts and planning processes are opportunities for diverse stakeholders to identify key lands for protection, protect habitat corridors and refugia, access funding opportunities, and develop projects to protect wildlife and build robust and resilient Sierra ecosystems.

C. Forestry Management Strategies

Global warming is expected to have widespread effects on the productivity and health of California's forests. Forestlands cover 45% of the state, most of it in the Sierra, and commercial forests, such as pine plantations, cover 16% of the state.¹¹⁶ If average statewide temperatures rise between 5.5 and 8°F, the productivity of mixed conifer forests is expected to decrease 18% by the end of the century.¹¹⁷ The reductions in yield from pine plantations are expected to be even more severe, declining 31% by the end of the century.¹¹⁸

Throughout much of the northern part of the Sierra Nevada, forest composition is expected to change from evergreen conifer forests (dominated by Douglas fir and white fir) to mixed evergreen forests (dominated by tan oak, madrone and live oak).¹¹⁹ Many of the Sierra's forests have undergone serious fragmentation and degradation from roads, poor forestry practices, and development. Forests are unable to migrate quickly enough as local climate changes due in part to this fragmentation.

In combination with these threats, the impacts of climate change can compromise forest resilience and distribution. Many pests that are currently limited by cold temperatures are expected to expand their range in the Sierra. Forests are ill-equipped to deal with their infiltration, as ecosystem health is already compromised by other human impacts and rising temperatures. At the same time, existing pests will be given longer times to flourish under warmer winters. Finally, climate change will exacerbate fire risk in the Sierra as conditions get hotter and drier.

The California Department of Forestry, the Board of Forestry, the US Forest Service (USFS), other federal land managers, non-profits, tribes, and private forest owners need to work together to improve the resiliency of Sierra forests in the face of climate change. Numerous federal and state policies, regulations, and plans affect the conservation and use of these forests. The following planning and management forums provide opportunities to address climate change:

- **California Forest Practices Act:** Created by the State Board of Forestry and Fire Protection to regulate logging on privately-owned lands to ensure that logging is done in a manner that will preserve and protect native fish, wildlife, forests, and streams. The rules apply to everything from small commercial harvesting operations to thousands of acres run by large timber companies. There are sections that apply statewide as well as regulations that are unique for specific districts. Follow the link to view the entire document: http://www.fire.ca.gov/resource_mgt/downloads/2010_FP_Rulebook_w-Diagrams_w-TechRule_No1.pdf.
- **National Forest Land and Resource Management Plans (Forest Plans):** These plans are required under the National Forest Management Act (NFMA), which governs the management of the National Forests. The Forest Planning Rule provides regulatory requirements for the development of Forest Plans for each National Forest unit. In 2005 and 2008, the Bush Administration made revisions to the Planning Rule which were later overturned in court, and currently either the 2000 Rule or 1982 Rule are used for forest planning activities. A copy of the 2000 Planning Rule as Amended in 2009 can be viewed at this link: http://www.fs.fed.us/emc/nfma/includes/2009_12_18_2000RuleFed_Reg_Notice.pdf.

- **Timber Harvest Plans (THPs):** These plans are submitted by landowners to the California Department of Forestry and Fire Protection (CalFire) outlining what timber they want to harvest, how it will be harvested, and the precautions that will be taken to prevent environmental damage. THPs are prepared by licensed Registered Professional Foresters (RPFs) to create comprehensive and detailed plans that range from about 100 pages to over 500 pages. A THP must comply with state and federal forestry and environmental regulations, or it is returned to the RPF and approved after the RPF and landowner agree to make the necessary changes. All approved THPs are subject to follow-up inspections and can be shut down and/or fined if illegal operations are found. For more information or to view the status on a THP check out http://www.fire.ca.gov/resource_mgt/resource_mgt_forestpractice.php. For a more detailed understanding of CalFire’s role in THP process check out http://www.fire.ca.gov/resource_mgt/downloads/CDFSROLE20057_05.pdf.
- **National Environmental Policy Act (NEPA):** USFS published a document “Climate Change Considerations in Project Level NEPA Analysis,” in January 2009. The document can be viewed here http://www.fs.fed.us/emc/nepa/climate_change/includes/cc_nepa_guidance.pdf.

These plans and other policies or regulations should be amended to include the following actions:

Use adaptive management strategies to maintain flexibility

- **Maintain historic fire regimes and monitor changes:** Sierra Nevada ecosystems developed in balance with a natural fire regime. These natural patterns are thus a critical ecosystem process. Fire is often a primary determinant of a forest’s species composition. In fire-prone regions, for example, fire-tolerant species dominate. For these species, infrequent, hot fires are important for seed germination and suppression of faster-growing but fire-susceptible species. By suppressing natural fires, fire-tolerant species become competitively disadvantaged.

Historic fire regimes will undoubtedly shift as a result of climate change. For example, the average fire return interval in a given area may increase or decrease as a result of changes in vegetation, moisture, and other factors. Because of regional differences in fire ecology and the lack of data on how fire ecology will change, fire policies established in response to climate change should not be uniform; rather they should be based on what is known of the fire ecology of a particular region and forest type, and they should be adapted to respond to changing conditions.

Letting natural fires burn when possible while ensuring communities have defensible space and compact land use will remove stressors and increase the resilience of Sierra forests. For communities concerned about wildfire under natural fire regimes, the most beneficial response is to manage community growth patterns and do fuel reduction in a limited interface around the existing community, not to manage fires. Establishing compact growth patterns and at least 100 feet of defensible space, as outlined under *Section E: City and County Land Use Planning Strategies*, are the most effective strategies to prevent damage to human communities from fires as well as allow ecosystems to gain the benefits of fire.

Monitor & track changes in weather, hydrology & ecosystems

- **Actively manage pests:** In ecosystems where pests are predicted to have a significant impact in the system outside the normal range, an active management program to reduce the negative effects of the pests should be devised. U.S. Department of Agriculture (USDA) Integrated Pest Management Programs need to build climate change modeling and monitoring into all their projects.

The USFS Pacific Southwest Research Station published *Review of Literature on Climate Change and Forest Diseases of Western North America* (2009) which summarizes literature on relationships between climate and various types of tree diseases and the potential effects of climate change on pathogens in western North American forests. For the most part, climate change is expected to have adverse effects on forest ecosystems. The publication can be viewed online at http://www.fs.fed.us/psw/publications/documents/psw_gtr225/.

Promote resiliency of existing ecosystems and minimize stressors

- **Maintain diversity:** Because climate change will have varying impacts upon different species and age classes of trees, it is essential to maintain a diversity of age stands and mix of species. This will contribute to maintaining productivity of the forest system as the climate changes. According to the 2009 United Nations report *Forest Resilience, Biodiversity, and Climate Change*, this is a key strategy to ensuring forest “resilience to human-induced pressures and is...an essential ‘insurance policy’ and safeguard against expected climate change impacts.”¹²⁰
- **Reforestation:** The CA Forest Improvement Program (CFIP) has reforested over 1,600 acres as of 2008. In addition, the USFS planted about 86,000 acres in California in 2007 and 2008. Total CalFire sequestration projects store over 5 MMTCO₂e (million metric tons of carbon dioxide equivalents) per year.¹²¹ Reducing 1 MMT of CO₂ emission is equivalent to saving 2.3 million barrels of oil.¹²² Projects should focus on restoring native tree cover on lands that were previously forested and are now covered with other vegetation types.
- **Avoid fragmentation and provide connectivity:** Roads and other development exacerbate the effect of a warmer climate by increasing the incidence and rate of pest and disease invasions by encouraging the dispersal of invasive species. The proliferation of roads also encourages more human use resulting in the potential for increased wildfire. Roadless areas serve as habitat and migration corridors for threatened and endangered species, provide quality recreational opportunities, protect against invasion of non-native species by keeping ecosystems intact, protect watersheds, and store significant quantities of carbon. See *Section B: Wildlife and Habitat Protection* and *Section* above for mechanisms to keep areas roadless and protect habitat connectivity.
- **Protect functional groups and keystone species:** Maintaining the natural diversity of species and functional groups in forests is a sound overall strategy for enhancing both resistance and resilience to climate change. Reduction of single species plantations is important, because studies demonstrate increased tolerance to environmental extremes and recovery potential as species richness increases. Mature forests have

well-established root systems, and are therefore better able to withstand drought-like conditions, whereas younger forests and post-disturbance stands are more vulnerable to decreases in moisture.

- **Reduce threats to forest resiliency:** The most obvious strategy for improving forest resiliency to climate change is to promote overall ecosystem health. Identifying and prioritizing the reduction of fragmentation and degradation will go far in ensuring that forest structure, composition, and function increase a forest's resiliency.
- **Protect mature forests:** There is a widespread and misguided belief that logging or clearing mature forests and replacing them with fast-growing younger trees will benefit the climate by sequestering atmospheric CO₂. While younger trees grow and sequester carbon quickly, the fate of stored carbon when mature forests are logged must also be considered. When a forest is logged, some of its carbon may be stored for years or decades in wood products. But large quantities of CO₂ are also released to the atmosphere, immediately through the disturbance of forest soils, and over time through the decomposition of leaves, branches, and other detritus of timber production. One study found that even when storage of carbon in timber products is considered, the conversion of 5 million hectares of mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon to the atmosphere.¹²³

Mature forests and other forest areas with recognized high conservation value should be fully protected. Even careful commercial forestry operations in high conservation value forests impose substantial costs to other forest ecosystem services such as biodiversity conservation, watershed maintenance, recreation, and other forest amenities. These forests should not be managed for timber or biomass.

- **Prevent conversion to plantations and practice low intensity forestry:** Forestry operations that minimize soil disturbance and avoid clearcutting and chemicals help reduce the invasion of exotic species and the loss of carbon from the soil. Old forests are more efficient carbon storage sinks than planted tree farms because of the high duff layers, organisms in the soil, large trees, downed logs, and canopy. Clearcutting releases massive amounts of carbon into the atmosphere. It will take hundreds of years before the little trees that are replanted after clearcutting replicate the carbon storage capacity of a mature forest.
- **Critically evaluate biomass power proposals for ecological sustainability and to support restoration:** Biomass power is still a smokestack-based form of energy production that emits carbon into the atmosphere through intensive combustion. However, appropriately scaled biomass could support ecological restoration, be community-based, and not create demand or pressure to harvest large trees. Scaled biomass could facilitate restoration that focuses on removing some smaller trees and could protect habitat from uncharacteristic fire. Biomass fuels should be by-products of restoration rather than harvested for the sole purpose of producing biomass power. Biomass is not a replacement for restoring natural fire to the Sierra, nor is it a completely carbon-neutral renewable energy source. Communities should have open and honest discussions of the positives, negatives, and short-term and long-term impacts of biomass in the Sierra before laying the infrastructure for a new industry.

D. Wildfire Management Strategies

Although some models suggest that climate change results in increased frequency and severity of wildfires, it is important to remember that climate change is affecting regions in different ways. Some regions are expected to experience more fires whereas other areas are going to experience fewer. Changes in plant composition are expected as plants from lower altitudes shift to more suitable conditions in higher altitudes. The precipitation patterns will also change. Winter precipitation may start to fall as rain instead of snow in the higher elevations, which will reduce the amount of snowpack and reduce the amount of in-stream water during the summer. In addition, as temperatures rise, the likely burn period will start earlier in the spring and last longer in the fall.

All these factors play an important role in fire regimes and may lead to larger fires than normal in places that would normally burn in a low-moderate fire regime. Fire is an integral part of Sierra forest ecosystems, and currently we are in a fire deficit due to a hundred years of fire suppression. For the interplay between fire and forest management to preserve ecosystem health and resilience, please see *Section C: Forest Management Strategies*. The focus of this section, however, is to address the compounding influences of fire suppression and climate change and suggest actions for communities and individual homeowners to reduce the risk of wildfires damaging existing private property within the wildland-urban interface (WUI). The West is warming, the risk of large wildfires in California is expected to increase about 20% by mid-century and 50% by the end of the century, and Sierra communities within high-fire risk areas need to be prepared as well as take steps to reduce their vulnerability.¹²⁴

Homeowners and developers should take care to use ignition-resistant building materials and create defensible space around existing and new homes. The Sierra Nevada Alliance's *Sierra Nevada Yard & Garden Guide* provides simple advice and guidance on how to protect your home from wildfire as well as protect water quality, preserve soils, use native plants, and conserve water. Local fire safe councils are excellent resources for support in creating defensible space.

Beyond the individual home, communities and counties should use the tools of urban planning to prevent further development in wildfire-prone areas, thereby reducing the risk of wildfire and costs associated with protection. See *Section E: City & County Land Use Planning Strategies* as well the Sierra Nevada Alliance publication, *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada*, for more information.

Lastly, communities, neighborhood associations, and land management agencies should partner with Fire Safe Councils to design community wildfire protection plans and fuel treatment programs to reduce fire hazard in wildland areas adjacent to communities. Community Wildfire Protection Plans (CWPP) are required by the National Fire Plan and to obtain government funding. These plans should include ongoing monitoring and adaptive management strategies to respond to changing fire regimes. Sierra Forest Legacy has developed a conservation-focused wildfire protection plan template that enables communities to plan how to reduce the risk of wildfires by identifying sites and methods for fuel reduction, developing funding priorities, integrating biodiversity and habitat concerns, and supporting comprehensive and locally supported solutions. To find out more about these plans and how to develop one, check out Sierra Forest Legacy's *Sierra Nevada Community Conservation and Wildfire Protection Plan Guidebook* at http://www.sierraforestlegacy.org/CF_CommunityProtection/CC_WildfireProtectionPlanning.php.

States have been asked by the federal government to provide lists of communities that are at high risk of damage from wildfire that border federal lands. Due to California's extensive wildland-urban interface (WUI), CalFire and California Fire Alliance continually update a list of Communities At Risk (CARs) to keep track of communities that have high threat of wildfire (even if they don't border federal land). Visit http://www.cafirealliance.org/communities_at_risk/communities_at_risk_addtolist to see if your community is on the list or to see the procedure to put your community on the list. You can also view http://cdfdata.fire.ca.gov/fire_er/fpp_planning_plans to see your county's current fire management plan. CalFire is also in the process of working with local government to identify high-fire hazard severity zones within counties. The Very High-Fire Hazard Severity Zone (VHFHZ) maps are currently being updated but the originals can be viewed here http://cdfdata.fire.ca.gov/fire_er/fpp_planning_severehazard.

Identify possible future changes through modeling

- **Model wildfire behavior:** Powerful new tools such as fire behavior modeling allow fire managers to map probable wildfire behavior in a given area. These tools can be used to model a variety of different future scenarios. The results can then be used to support the development of community wildfire protection plans, design and prioritize fuel treatments, and identify areas which are inappropriate for development. As explained before with watershed and climate models, wildfire models are only as useful as the data used to inform them. In this case, resource managers should take care not to take these models as predictors of the future, but providing some likely future scenarios.

Monitor & track changes in weather, hydrology, and ecosystems

- **Monitor changes in fire behavior and fuels:** Fire managers should monitor changes in wildfire frequency and severity, fire return interval, changes in fuel type and load, and average temperature and humidity, and feed this information into planning and response efforts.

The Sierra Nevada Adaptive Management Project (SNAMP) is a group of researchers from the University of California, University of Minnesota, US Forest Service (USFS), the California Natural Resources Agency, and the U.S. Fish and Wildlife Service that is currently working together to study how forest vegetation treatments affect fire risk, wildlife, forest health, and water. By studying two vegetation management treatment sites in the Sierra Nevada forests, the group is able to implement and test adaptive management strategies. In analyzing the results, SNAMP hopes to improve management practices, improve forest health, and protect water resources. To find out more about SNAMP, go to their website: <http://snamp.cnr.berkeley.edu/>.

Use adaptive management strategies to maintain flexibility

- **Create adaptive wildfire management plans:** Community wildfire protection plans (CWPPs), fuel treatment programs, and other wildfire management plans should be designed to respond to changing fire behavior and fuels.
- **Manage the forested landscape to restore resiliency and reduce uncharacteristic fire risk:** Sierra forests are already stressed due to 150 years of fire suppression and logging.

The resulting reduction in fire in forest ecosystems that naturally depend of fire, as well as other human caused impacts, has stressed these ecosystems. Climate change will add additional stress for most regions in the Sierra. State, federal, and local agencies should promote fire restoration policies that will make Sierra forests healthier and more resilient while also investing in fuel reduction programs within the WUI (such as controlled burning and hand-thinning of small trees and brush) to reduce the risk of fire in communities and prevent damage to existing residential areas. Maintaining a proper balance between small and fire-resilient large diameter trees as well as preserving diversity will increase the resilience of Sierra forest ecosystems. For more information on restoring wildfire and increasing forest resilience outside the WUI, see above *Section C: Forest Management Strategies*.

Prioritize projects that will succeed under multiple scenarios

- **No new parcels in high fire risk areas:** Use zoning and the development code to restrict the creation of new parcels in high risk areas outside fire district boundaries. Maintain zoning in these areas at very low densities, such as 320 acres per parcel. Existing smaller parcels are grandfathered in such ordinances, but at least further parcelization is prevented.

Currently, taxpayers are subsidizing unsafe growth as the costs of fire prevention by state and federal agencies has grown exponentially and new development is sited in or near wildland areas. The majority of the costs are not being shouldered by the affected homeowners or local jurisdictions that allowed development in high-fire risk areas. For example, USFS spends \$1 billion annually to protect private homes adjacent to national forest lands.¹²⁵ To further prevent new parcels in high-fire risk areas, avoid the risk of property damage, and lower costs to tax-payers, rural county governments and developers who approve and fund growth in fire prone landscapes should cover the fire-fighting costs associated with those decisions.

- **Create defensible space:** Good defensible space acts as a line of defense for your property when wildfire roars into your community. There is no guarantee of immunity from wildfire, but defensible space measures have proven to reduce or minimize property loss in some cases. Measures like trimming low branches of trees, keeping a Lean, Clean, and Green zone within 30 feet of the house, and storing wood away from the house can help minimize the risk of fire damage. The Sierra Nevada Alliance's *Sierra Nevada Yard & Garden Guide* provides clear direction and steps for Sierra residents to better protect their homes from wildfire while also protecting Sierra water, soils, and wildlife.

Local governments should also help ensure compliance by creating mandatory defensible space requirements and doing outreach, education, and enforcement to assist local homeowners.

- **Use ignition-resistant building materials:** New development in wildfire hazard areas should be required to use ignition-resistant building materials, and existing homes should be retrofitted to the extent possible.

Integrate and coordinate efforts

- **Strengthen CEQA requirements for fire hazard:** The California Environmental Quality Act (CEQA) encourages agencies to consider wildfire hazard as a potential impact that should be examined and mitigated. However, this provision is rarely utilized, and many projects that would increase the risk of catastrophic wildfire are approved without mitigation. The State of California should revise CEQA to clarify how impacts should be analyzed and suggest mitigation measures.
- **State and federal agencies can support local actions:** CalFire and USFS already play an important role in local planning in some parts of the Sierra by reviewing draft plans, codes, and development applications, and making recommendations. CalFire and USFS could expand their role in local policy development by providing technical assistance, planning grants, stakeholder convening, and policy development in partnership with local governments.
- **Assess true costs of fire protection and budget accordingly:** Most Sierra counties lack the funding needed to adequately fund fire prevention. Funding mechanisms such as developer impact fees and assessment districts are non-existent or woefully inadequate. Local governments should examine the true, long-term costs of fire prevention and protection and create or expand these mechanisms to attain budgetary needs.

To improve fire safety in developed areas, local governments and voters can establish a fire assessment district. A fire assessment district is a special district formed by a local government agency and includes property that will receive direct benefit from new public improvements or from the maintenance of existing public improvements. The local agency that forms the assessment district sells bonds to raise the money to build or acquire the public improvement. The agency then levies a special assessment against each parcel of land within the district, which is included on the county's general property tax bill. Revenue generated from annual assessments should be used to fund the local fire districts and fire reduction programs.

For more information on other local government actions and potential revenue mechanisms for addressing wildfire, see page 22 of the Sierra Nevada Alliance publication *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada*.

- **Improve planning and budgeting processes to fully address risk:** All levels of government involved in wildland fire prevention need to improve planning and budgeting to adequately plan and prepare for coordinated wildfire prevention and response efforts in response to increasing wildfire hazard to communities.

E. City & County Land-Use Planning Strategies

When deciding where and how the Sierra will accommodate population growth, climate change is an important consideration, both in terms of reducing emissions to prevent catastrophic change, and adapting to the changes already underway. Sprawling land use patterns increase greenhouse gas emissions by encouraging longer commutes and discouraging walking, bicycling, and alternative transportation. On the flip side, the impacts of climate change — such as extreme weather, wildfire danger, and flooding — will increasingly affect the integrity of the built environment unless action is taken now.

Community-Wide Land Use Impacts

Climate change has already begun to affect the safety and sustainability of Sierra communities, and future impacts could be severe if action isn't taken to minimize hazards through improved land use planning.

Wildfire is at the top of the list of climate-induced community hazards. As Sierra summers become hotter and drier, the risk of homes and lives being lost to catastrophic wildfire is increasing. The 2007 Angora Fire, near South Lake Tahoe, is a good example of how reduced snowpack, sprawling development in a high-fire danger area, and high summer temperatures can combine to create an extremely dangerous fire season. These risks can be reduced through better land use planning that limits the incursion of development into fire-prone wildland areas.

In every community there are areas which are more dangerous to develop, and areas which are safer. Topography, vegetation, slope, proximity to existing emergency services, roads, and municipal water supply are just some of the features which can help determine which areas are safe for development and which are more dangerous. By looking at fire danger at the scale of the entire community, rather than the individual property, city planners and fire managers can direct growth into safer areas and limit development in areas of extreme hazard that are likely to be more dangerous in the face of increased climate change.

As climate change impacts the Sierra's hydrology, leading to more rain and less snow, flooding may also become an issue. Many Sierra communities are built in river canyons or floodplains where extreme floods may jeopardize homes and buildings. Land use planners need to take these potential impacts into account and avoid allowing new development near Sierra rivers and creeks that may flood during extreme weather events.

Hydrologic changes may also affect water supplies. Most new development in the Sierra relies upon private or semi-private wells, yet the aquifers which supply this groundwater are poorly understood. Just as climate change will affect the surface water in our rivers and creeks, it will likely affect our groundwater aquifers as well. Sierra planners and water providers should work together to better understand our Sierra aquifers, and ensure that new development has a stable and predictable source of water over the long term.

As temperatures warm and the Sierra experiences more extreme events (like heat waves), Sierra communities may expect to see higher rates of mortality and morbidity, increased air pollution, changes in allergens, increased exposure to disease vectors (such as Lyme disease and West Nile Virus), and reduced water supply, among other public health impacts. California heat waves alone have killed more people than all other declared disasters in California combined over the past fifteen years.¹²⁶ Vulnerable communities, including the elderly, infants, disadvantaged communities, individuals with chronic conditions, and those who work outside, will likely be more adversely affected by these changes.¹²⁷ Local governments need to increase resilience of Sierra communities, particularly vulnerable populations, by promoting healthy living and taking precautionary steps such as developing guidelines for dealing with public health impacts of extreme weather events like heat waves in order to prepare for these likely changes that will affect public health and safety.

Site-Specific Land Use Impacts

Buildings have a significant impact on the environment. They account for approximately 40% of total energy use, 71% of electricity use, and 33% of all CO₂ emissions in the United States. Buildings also account for 40% of all materials and wood use and 25% of all water use in the United States.¹²⁸ Decision makers should both consider how buildings and their locations impact their local environment and in turn how changes in climate will affect the building's long term sustainability.

New buildings need to be able to withstand the impacts of climate change over the next 50 to 80 years to guarantee their long-term sustainability. Buildings could be adversely affected by extreme weather events' fluctuations in temperature, and precipitation affecting the buildings structural integrity, external fabric, internal environment, and service infrastructure.

Developers and those who invest in new development should consider the environmental implications of climate change as a key component of the business case for investing in and building a development. Well-designed buildings that are properly protected from climate change risks will be easier to sell or rent and can be sold at a higher price. The Sierra Green Building Association (SiGBA) is a great example of an organization promoting these well-designed environmental buildings and business practices for sustainable lifestyles throughout the Sierra region. To achieve this goal, they advocate for resource efficiency by providing education and support on energy, site development, building materials, air, water, and waste. For more information, go to their website: <http://www.sigba.org/>.

The location and design of new buildings should both reduce greenhouse gas emissions and minimize vulnerability to climate change. Acting early may mean that resilience to climate change can be incorporated into the planning and construction process at a relatively low cost. In the longer term, building climate resilience into new buildings and development will avoid unnecessary climate-related damages and costs, as the impacts of climate change begin to be felt more intensely. It will also avoid the need for expensive retrofits.

In addition, with the growing impacts of climate change, building regulations and codes will change. By failing to anticipate future requirements, there is a risk that more expensive remedial measures may need to be taken at a later date to ensure compliance as new legislation or regulation comes into force, such as the California Green Building Standards Code.

City and County General Plans and CEQA are the clearest opportunities for county planning departments, developers, contractors, architects, non-profit organizations, and others to ensure implementation of community-scale and site-specific actions to both reduce emissions (see Chapter 3) and adapt to climate change. Here is a quick overview of these plans:

- **City and County General Plans:** California law requires each city and county to adopt a General Plan “for the physical development of the county or city, and any land outside its boundaries which bears relations to its planning”.¹²⁹ A County General Plan is a blueprint for growth and development in unincorporated areas of the county (i.e. areas not within the jurisdiction of a city). A City General Plan serves the same purpose for the area within the city's jurisdiction. A good General Plan represents the community's vision of its future and is created by a highly inclusive, collaborative community process.

All General Plans must contain the following seven elements: land use, circulation, housing, conservation, open space, noise, and safety.¹³⁰ Many cities and counties choose to expand their plans to address additional issues including water, wildfire, community design, air quality, and public facilities.

Once a General Plan is adopted, all subdivision, public works projects, and zoning decisions must be consistent with the General Plan. Local regulations, codes, and ordinances work at a finer level of detail to specify the type, location, and form of development.¹³¹

For more information on General Plans and their requirements, you can consult California Office of Planning Research's *A Citizen's Guide to Planning* at http://ceres.ca.gov/planning/planning_guide/plan_index.html#anchor156525. You can also find California's General Plan guidelines, as well as links to every City and County General Plan or planning department, at <http://www.opr.ca.gov/index.php?a=planning/gpg.html>.

To find out more about land use planning in the Sierra, check out the Sierra Nevada Alliance publications *Planning for Water-Wise Development in the Sierra: A Water and Land Use Policy Guide*, *Dangerous Development: Wildfire and Rural Sprawl in the Sierra Nevada*, and *Planning for the Future: A Sierra Nevada Land Use Index* at www.sierranevadaalliance.org.

- **California Environmental Quality Act (CEQA):** (See the informational box on page 32 for more information on CEQA). CEQA is required for almost any development proposal or land use planning process, like County General Plans, at the local level. Within the context of local land use planning, CEQA is a tool for community members to frame the debate about growth in your community as well as an enforcement mechanism for ensuring local government follows the law when approving development projects.



“Grand Oak, Sierra Foothills” © ElizabethCarmel.com

More than three-fourths of oak woodlands are privately owned in Sierra Nevada counties and are susceptible to private development.

In practice, CEQA operates by requiring state and local government agencies to thoroughly examine environmental concerns when making decisions and to make the decision-making process open and accessible to the public. Specifically, before any public agency undertakes or approves a project, that agency must 1) identify potentially significant environmental effects of the project, 2) choose alternatives that would avoid or substantially lessen the significant environmental effects, and 3) mitigate the significant environmental effects, where feasible.¹³²

To find out more about CEQA and how community members can shape smart land use planning in the Sierra, consult the Sierra Nevada Alliance publication *Saving Sierra Places: An Activist's Toolkit for Winning Land Use Campaigns* at <http://www.sierranevadaalliance.org/publications/> and Planning and Conservation League's *Community Guide to CEQA 3rd edition* at <http://pclfoundation.org/events/ceqaguide.html>.

These plans need to incorporate the following recommended actions to ensure the resilience of Sierra communities in the face of climate change:

Community scale actions

Prioritize projects that will succeed under multiple scenarios

- **Promote infill and transit-oriented development:** Putting new development within existing communities, rather than allowing outward sprawl, will minimize greenhouse gas (GHG) emissions and help keep new development safer from wildfire and flood hazards. Local governments should identify infill sites and encourage development of these areas to accommodate population growth. Tools such as redevelopment, transfer of development rights programs, and fiscal incentives can be used to encourage infill development. The Town of Truckee uses its planning authority and its redevelopment agency to promote infill projects along the Truckee downtown area. It recently approved a major mixed-use infill project, the Railyard, adjacent to the existing downtown. To learn more about the project, go to <http://www.truckeerailyard.com/>.
- **Encourage contiguous outward growth:** Where there is no room for infill development, local governments should encourage contiguous outward growth that is compact and mixed. As with infill development, such growth patterns will minimize GHG emissions and discourage development in unsafe areas. Tools such as General Plans, urban growth boundaries, and urban reserve systems can be used to foster concentric growth patterns.
- **Cluster development:** Redevelopment or new development should be designed to optimize walkability, safety, and access by clustering new lots in low-hazard areas close to existing roads and neighborhoods. Clusters of development should be surrounded by a shared zone of defensible space. Local governments can require clustering as part of the General Plan, zoning code, and/or subdivision regulations. Analytical tools such as fire behavior mapping can be used to assist planners and landowners in ascertaining the safest locations for new development. Mariposa County's General Plan attempts to manage growth by facilitating growth near existing infrastructure. For example the Town of Truckee promotes cluster development in order to protect and preserve open space.

- **Don't build in unsafe places:** Within a given area, some places are more prone to fire danger or flooding than others. Brushy areas, steep slopes, ridgelines, and south-facing hillsides, for example, are often more fire-prone than other areas within the surrounding landscape. Other areas may pose a particular threat to an established community, such as a canyon choked with brush that sits adjacent to a town. New development should be curtailed in places that put new or existing residents at increased risk of uncharacteristic wildfire or flooding. Between 1990 and 2000, 97% of the Sierra's population growth occurred in areas classified as extreme or very high fire threat by CalFire. Today, 94% of the land selected for development in the Sierra is in extreme or very high fire threat areas.¹³³
- **In unsafe places, build in safe patterns:** Local governments should strongly discourage new development in areas far from existing towns and communities. However, in situations where development is unavoidable due to existing entitlements, new homes and structures should be situated to minimize exposure to wildfire and flood hazards.
- **Adopt climate-friendly zoning and building codes:** Counties in the Sierra need to re-examine zoning codes and building requirements to take climate change impacts into account. Cities and counties must adhere to the new *California Green Building Standards Code* and should consider adopting the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) and Neighborhood Design (LEED-ND) rating systems to assist planners, developers, and the public with designing and building green buildings and communities.

Use adaptive management strategies to maintain flexibility

- **Build communities to be adaptable to climate change:** Sustainable development can reduce vulnerability to climate change by enhancing adaptive capacity and increasing resilience. At present, however, few plans for promoting sustainability have explicitly included either adapting to climate change impacts or promoting adaptive capacity. Developers and planners need to follow Smart Growth principles when planning future development. When planning new development, planners need to integrate features such as compact development, reduced impervious surfaces, and improved water retention, energy and water efficiency, safeguarding of environmentally sensitive areas, mixing of land uses (e.g. homes, offices, and shops), and ensuring that communities are walkable and bikeable.

The Sierra Nevada Alliance's Sustainable Sierra Communities Program recently launched a Seeds for Sustainability Campaign to work with Sierra communities to collaborate on visions for sustainable communities and the plan to achieve that vision. To get more information and resources, check out <http://www.sierranevadaalliance.org/programs/program.shtml?type=pgm02>.

The Alliance for a Post-Petroleum Local Economy (APPLE) in Nevada City is another wonderful resource for individuals interested in more information about building sustainable communities. For more information please see <http://www.apple-nc.org/nevadacitytaskforce>.

- **Examine climate change impacts and adaptation strategies as part of CEQA review:** When undertaking CEQA review for land use plans and specific development proposals, counties and cities must address emission reduction and should also address adaptation

to changing climate conditions including ongoing monitoring to ensure that projects are adequately adapting to a changing climate.

- **Create transportation alternatives and policies** to shift automobile trips to walking and bicycling, particularly trips to locations that are close to home such as schools, parks, and stores. Integrating walking and bicycling is appropriate because 25% of all trips people take are less than one mile, but 75% of those trips are made by car when they could be made on foot or by bicycle.
- **Build water-wise communities:** Before approving new development, counties and cities should ensure that there will be an adequate water supply for the slated development and for all future development allowed in their land use plan. Knowing the limits of the aquifer or other water supply sources, ensuring the efficiency of water delivery methods and infrastructure, and using graywater are all essential components of smart development in a world impacted by climate change.

Monitor & track changes in weather, hydrology, ecosystems, and communities

- **Accurately assess and survey land use patterns and features in your county:** In order to better protect open space, working landscapes, and wildlife migrations corridors, it is important to accurately assess land use, ownership, and zoning. Counties, states, conservation organizations, land trusts, and property owners should work cooperatively to assess land use patterns and develop large-scale land use plans that achieve the complementary goals of determining which habitats should receive some form of protection and which land is suitable for development.

Integrate & coordinate efforts

- **Integrate land use planning into water planning,** and water planning into land use planning to ensure conservation of natural resources and energy. Consult the Sierra Nevada Alliance's publication *Planning for Water-Wise Development in the Sierra: A Water and Land Use Policy Guide* for specific recommendations on how to better integrate land use and water planning. In addition, land use planners should actively participate in Integrated Regional Water Management Planning to share their expertise, share resources (e.g. modeling and research), and ensure that final water plans meet land use and development needs. Consider developing a County General Plan water element in conjunction with the IRWMP.
- **Bring fire and emergency agencies to the table:** Local governments should ensure that fire safe councils, local fire departments, CalFire, USFS, and other emergency response agencies have a meaningful role in land use planning efforts and decisions.
- **Bring public health officials and disadvantaged communities to the table:** Local governments should ensure that public health officials and advocates, disadvantaged community representatives, tribes, and other stakeholders should be involved in land use planning processes in order to:
 - ◆ Develop and implement outreach to vulnerable populations and provide them with the information and tools to prepare for the current and future impacts of climate change.

- ◆ Ensure local governments adopt policies that support healthy, resilient Sierra communities such as establishing local farmers markets to make local, organic food available or making the community more bicycle and pedestrian friendly.
- ◆ Support and implement community engagement projects and programs. Active community members and local support networks will be a vital foundation for Sierra communities to be resilient in the face of climate change and other challenges.¹³⁴
- **Use financial incentives to encourage conservation and smart growth:** Private and public landowners will be motivated by financial incentives to implement some suggested adaptations. It will be important for the state and federal governments to develop grants, subsidies, and tools such as conservation easements to encourage landowners to take the necessary steps to preserve Sierra landscapes in the face of climate change.
- **Support programs that protect open space, working landscapes, and important habitat:** State and federal government agencies can provide grants to local governments to assist with conservation easements and fee-title acquisition of lands that should remain undeveloped. In addition, state agencies can provide planning grants, decision support tools, and technical assistance to help communities and counties do better planning.

Site-specific actions

Use adaptive management strategies

- **Design site layouts to be climate change friendly:** On individual lots, building sites should be chosen to minimize wildfire and flood hazards and maximize passive heating and cooling. Site layouts should minimize solar gain in summer, maximize natural ventilation, and maximize native vegetation. Local governments can use zoning codes and building codes to achieve these requirements.

Prioritize projects that will succeed under multiple scenarios

- **Ensure that building structures withstand future hot and cold extremes:** Incorporate appropriate ventilation and cooling techniques to withstand hot and cold extremes of the future. Drainage systems and entrance thresholds need to be able to cope with more intense rainfall. The exterior of buildings should reduce heat gain in summer, for instance with light colored paints. Construction materials need to be able to perform adequately in the climate throughout the lifetime of the development. Cooling and ventilation systems, where necessary, should be designed to use as little carbon-based energy as possible by using renewable energies and being as energy-efficient as practical.
- **Ensure water flows appropriately on and off a property to reduce flooding and for watershed protection:** Ensuring your property captures stormwater helps reduce flooding and reduces the conveyance of sediment and pollutants off your property. Stormwater capture will become more important as severe weather events increase. The key actions to take are to capture as much stormwater on your property as

possible, then convey the stormwater to an area where it can infiltrate into the ground. There are a number of agencies and entities who provide resources for capturing, conveying and infiltrating stormwater. Contact your local water utility district or the federal Environmental Protection Agency. The Sierra Nevada Alliance's *Sierra Nevada Yard and Garden Guide* (which can be found at www.sierranevadaalliance.org/publications) also has further discussion and resources addressing stormwater capture.

- **Use water wisely:** Water-wise landscaping makes use of native plants, planting materials, irrigation technologies, and other practices to increase water efficiency while providing a beautiful landscape. In addition, external water use can be reduced by encouraging the recycling of rainwater or using graywater for irrigation purposes, car washing, etc. Ensure water features have minimal net water use.
- **Design outdoor spaces for a changing climate:** Ensure the selection of vegetation with longer life (over ten years) takes into account climate change. Will the trees you plant today thrive in a warmer climate ten years from now? If your climate is predicted to be warmer, do you need to design for more or different areas of outdoor shade? Outside spaces could also be designed to provide habitat to accommodate predicted changes in wildlife populations.

Questions to Ask Local Land-use Planners and Resource Managers Regarding Climate Change

Awareness:

1. Do you know how climate change is impacting or could impact your community or region?

Analysis:

2. Can you identify and assess the risks from climate change to your services, operations, and community?

Action:

3. Do your current policies, strategies, plans, and projects include provisions for the impacts of climate change?
4. Are programs, plans, projects, and developments with a lifetime of more than 20 years required to factor in climate change?
5. Have you briefed elected officials on any key risks arising from climate variability and long-term climate change?

Chapter 6: Communicating Climate Change in the Sierra

Effective communication is an important for helping others understand the need to both adapt to changes in climate and reduce emissions to try to prevent the most dangerous impacts of climate change. In addition, successful communication is essential for overcoming the many barriers that organizations, local governments, and individuals encounter when trying to implement actions to reduce emissions and adapt. This chapter offers key insights into developing a successful communication framework, crafting effective climate change messages, disseminating them to target audiences through trustworthy messengers, and resources for more information on climate change communication.

Obstacles to Communicating the Need for Action on Climate Change

When reaching out to others in your group, planning team, or community, specific concerns and issues often make it challenging for them to understand and move forward in addressing climate change. In our research of people's current perceptions and concerns regarding climate change, we found a number of perceived obstacles that effective communication can overcome.

Some of the main obstacles we found:

- They may be very busy with their own work. Adapting to climate change and reducing emissions may seem like overwhelming work and seem like a low priority compared to existing projects on their list.
- They may not realize that climate change is occurring now and that significant near and long-term changes will affect their lives.
- They may believe that there is too much uncertainty on the human causes of climate change and that acting on what they see as being less than solid facts is unwise.
- They may believe that federal emissions policies need to be more stringent and feel local actions are meaningless on a global issue.
- They may associate taking action on climate change with “environmental causes” and are put off due to personal beliefs.
- They may think that adapting to climate change acknowledges that humans are a cause of warming, which they may view as controversial.
- They may fear that there might be negative economic ramifications of addressing climate change in a meaningful way.

- They may think the issue is too difficult to understand and that the climate system is too complex to predict the future, particularly scientific models or climate forecasting.
- They do not see other local leaders addressing climate change, and they fear striking out on their own ahead of their peers and own leaders.
- They are overwhelmed by the scale and impacts of the problem.

These concerns can be addressed through communication of the facts, messaging, education, and discussion. The goal is not to argue with ardent skeptics, but to find common ground and work with reasonable people who are concerned, want to know more, and who are motivated to protect our communities in the face of change. We hope the following tips on communication, messages, and messengers will help you reach this reasoned center of people to move forward in planning and implementing adaptation and emission reduction strategies for the Sierra.

Summary of the Five Steps for Communicating Climate Change

An effective climate change communication plan uses the right message(s) delivered to the right people by the right messenger. While the rest of this chapter covers the five primary steps in identifying and designing your message, below are summaries and some questions to address at each step. They can be applied to strategies as complex as the creation of multi-year outreach campaigns or as simple as the creation of a single presentation for one audience in a rural community.

Step 1 – Define your Target Audience and Core Actions – Who can give you what you want or need? What desired behaviors or actions do you want to elicit from your target audience(s)?

Step 2 – Create Messages and Stories for your Target Audience(s) – What overarching story, frames, and messages will resonate with your target audience(s) and encourage, enable, empower, or incite the desired behavior or action?

Step 3 – Choose your Messenger – Which messengers (such as farmer, mother, scientist, elected official, doctor, or religious leader) does your target audience respect and listen to? Of the messengers your target audience listens to, who is most likely to work with you and deliver the chosen frames or messages?

Step 4 – Distribute the Message and Engage your Target Audience – What mediums (such as a newspaper ad, sermon, presentation at their meeting, flyer in their utility bill, or radio interview) are the best to package your message and ensure your message gets delivered to and resonates with the target audience(s)? What resources will you need to deliver the message using the chosen medium?

Step 5 – Evaluate Success – Based on the measurements of success you develop, which stories/frames, messages, messengers, and mediums were effective or not effective and why?

Step 1: Define your Target Audience and Core Actions

First, you need to determine what your program, project, or campaign goals and objectives are. Then, you need to ask yourself who can help you achieve those goals. Is it your neighbor? Is it your city council? Is it the fire department? Who makes the decision that makes your goal become a reality?

In determining who has the power to make your goal a reality, consider what specific actions are required to make the goal come true. Is it your neighbor voluntarily installing rain catchments? Is it the city council requiring all new developments to have rain gardens to catch runoff? Is it the fire department changing their fire code requirements to encourage fire defensible space and protect water quality? Identifying the core actions that make your goal a reality can help you better identify your true target audience.

The general public is rarely the target audience who can make your goal come true. Often your target audience is an official, decision-making body. Even if it is voluntary action by individuals or businesses, what is the geography you are trying to effect and what actions or suggestions (and by whom) will spur them to act? Be as specific as possible to make your effort feasible. For example, if you are trying to get homeowners in South Lake Tahoe to implement conservation best management practices, instead of targeting individual homeowners throughout the city, perhaps you could prioritize specific neighborhoods or blocks in the first year.

Step 2: Create Messages and Stories for Your Target Audience(s)

There are two forms of communicating your messages to your target audience(s) that, when combined, can be a powerful tool in achieving your goal(s). The first form of communication involves weaving your communication around key messages or talking points that you believe best reach your target audience. The second form is telling a story that identifies a problem, solution, hero/actors (the target audience/decision makers), and actions. A helpful resource in understanding the importance of stories and the larger tactic of framing messages is smartMeme's ReImagining Change which can be found at <http://www.smartmeme.org>.

When creating story-based messages:

- It is important to craft messages and stories for a specific audience. Some messages only work for one audience and others are effective for multiple audiences.
- You can often use a core story for all of your audiences, but the story can change to emphasize the different core values of each target audience.

Tips for Effective Climate Change Message Development

The following are important criteria to keep in mind when crafting your message, choosing a frame, and communicating on climate change adaptation and greenhouse gas emission reduction:

- **Always pair problems with solutions:** Never state a problem alone. Large-scale, devastating images and stories can disconnect audiences and foster a sense of denial. Problems paired with appropriate solutions allow people to stay engaged because there is hope.¹³⁵

- **Evoke personal experiences** to create personal interest in climate change adaptation and greenhouse gas (GHG) reduction efforts. Personalized communication engages the audience much more than generic, sanitized messages, and stories.
- **Provide accurate information:** Correct information is critical to retaining credibility and gaining trust.
- **Communicate a range of scenarios:** Climate change preparation is not about one definitive future but a range of potential futures. Communicate that we are certain that our future natural systems will be different from today, and provide sets of scenarios describing potential futures whenever possible. Communicating the scientific consensus that “tomorrow will not be like today” and that we are capable of planning for the range of scenarios helps your target audience or decision makers understand that action is doable and warranted.
- **Stress the precautionary principle:** The consequences of taking no action are severe. While we may not have 100% accurate climate forecasting, we know that precautionary actions have benefits and provide insurance for when the worse case scenarios occur. Even in the absence of complete certainty, risk management principles we use in day-to-day decisions dictate that we should act given the high certainty of extreme risk and the positive benefits of acting. Taking no action assures future problems, while actions that address climate change now are beneficial in a range of scenarios.

Sample Messages

Below are sample messages that we have divided into three categories. The first set conveys that climate change is happening and will have consequences, the second category addresses reducing emissions, and the third category addresses the need to take action to adapt to changes already underway. Make sure that when utilizing these messages, you match them to an appropriate target audience.

Climate Change is Happening

- **Scientists agree** that the Sierra is warming, snow is decreasing, fires are intensifying, wildlife is moving, and major weather events are occurring more often.
- **Climate change strains failing natural systems:** Our natural world is precious and is already jeopardized by contamination, environmental degradation, and overuse. Now our natural systems also face a serious new challenge in global climate change, which threatens to push our already failing systems to the breaking point.
- **Climate change is the new normal:** What we currently consider extreme weather and climate events, such as drought, may well be the new normal. Global warming is an emergency we can predict.

Reducing Emissions

- **The necessary tools to reduce emissions are available:** There are many tools and examples of easy, cost-effective ways to reduce emissions as individuals, businesses, and communities.
- **We cannot afford the wasteful actions of the past. Responsible and innovative resource management is needed:**
 - ◆ We cannot afford to destroy the environment and jeopardize our natural heritage by wasting water, energy, and natural resources through polluting practices and overuse.
 - ◆ Our current wasteful practices are a “lose-lose” for our communities and environment.
 - ◆ We need to adopt *cost-effective new approaches* and improved technologies.
 - ◆ *Innovative local communities* and businesses are leading the way by doing more with less.
 - ◆ *Smarter policies* promote efficiency and conservation and help us all do more with less by eliminating unnecessary waste.
 - ◆ We should upgrade our existing infrastructure to be more efficient.
- **Our security requires preventative action and preparedness – before it’s too late:** Creating a secure future for our state and communities means working to prevent extreme climate disruption before it’s too late. We should not gamble with our future. Global warming is an emergency we know is coming – just like earthquakes. We can prepare for potentially catastrophic effects on our natural systems.
- **Emission reduction is the most practical course, saving money and resources:** Saving water and energy saves money and reduces greenhouse gases. Particularly in these challenging financial times we need a more practical, cost-effective and proven approach to ensure reliable systems (such as water, energy, and fire protection) by reducing the demand!

Adapting to Climate Change

- **We must reduce emissions to prevent catastrophic climate scenarios, while we also adapt to the unavoidable changes already set in motion:** This is not a choice of reducing emissions OR adapting. We must take both actions for a secure future.
- **Science and resources exist to help** us adapt to the climate changes underway. There are resources and scientific information available to help you plan on the local level.
- **Planning now about how to adapt to climate change:**
 - ◆ is easier and cheaper than waiting for a crisis.
 - ◆ gives us time to come up with win-win solutions that are beneficial for all stakeholders.
 - ◆ allows us to come up with solutions that protect our natural resources and our local economies together. Addressing climate change can provide opportunities to create new jobs.

- **Future generations rely on us. Addressing climate change is our responsibility:**
 - ◆ Planning for climate change impacts now will make a difference by leaving a legacy of clean and adequate drinking water, healthy forests, stable fish and wildlife populations, and vibrant local communities and economies for future generations.
 - ◆ Everyone has a fundamental human right to a healthy environment, and therefore we must plan how to adapt to climate change to responsibly safeguard our most precious resources.
- **Planning how to adapt isn't an additional load, it's a mind-set change:** Adapting to and mitigating climate change can be part of existing planning processes.

Stories

Stories are important resources in communicating your efforts. People listen to and remember stories and rarely remember basic scientific document details or even facts. This may be because we have been telling stories for centuries in our cultures. Facts are important to use too, but incorporate them into stories and the key concepts will be remembered and repeated to friends and family.

Here is an example of one set of messaging told two ways: first using only facts and bullets and then using a story.

“Facts” and Bullet version:

(Please note that all “facts” are made-up and not true in this example and are shared only to provide a stylistic example.)

- 2 out of 13 children in South Lake Tahoe use the local trails to go to and from school and friend's homes.
- 100% of the local trails are on federal forest lands and are created by users recreating in the area.
- The local trails are polluting the local environment, are unsigned, and are in key wildlife corridors increasing wildlife urban interface.
- Climate change is reducing wildlife habitat by shortening the berry ripening season. This has increased bear activity in urban neighborhoods.
- 22 depredation permits were issued for bears in the Al Tahoe Neighborhood between 2010 and 2011 for bears breaking into garbage and homes.
- Wildlife scientists report an increased interaction of humans and wildlife and believe that climate change is playing a role.

Story version:

- It's 2024 and the Sierra is warmer and has a lot less snow. Once upon this future time there was a little girl named Goldilocks. Goldilocks got lost in the woods going from her grandmothers off Al Tahoe Blvd to her home in the Golden Bear neighborhood in South Lake Tahoe. She became very hungry, cold, and tired as she tried to find her way home on the unmarked forest trail system. Suddenly she came across an adorable

cabin in the woods. She went to the cabin and knocked and no one answered. She called out and no one came to the door. So Goldilocks broke into the house and to her amazement she found three bowls of porridge on the table. She was so hungry she sat down, but found the first bowl was too hot. She tried the second bowl and it was too cold. The third bowl was just right. Then she went upstairs, which was no small task given she was feeling so tired. She came across a room with three beds. The first bed was too hard. The second bed was too soft, but the third bed was just right. Then Goldilocks fell asleep. About 5:30 pm the Three Bears came home after a traumatic day of trying to find fresh berries for their porridge. Climate change is reducing wildlife habitat by shortening the berry ripening season. This has made life more difficult for the Three Bears. Mama Bear noticed that the porridge had been eaten while they were gone. Then Papa Bear noticed that his bed had been slept in. Then Baby Bear found Goldilocks in his bed. They woke up Goldilocks and escorted her home where she received quite a scolding from her parents for not taking her map with her and breaking and entering. The elder Locks profusely thanked the Three Bears and promised not to tempt them in the future with garbage in unsecured trash cans and would no longer ask for depredation permits to kill the bears for breaking and entering into their garage for the garbage (after all, wasn't that just what Goldilocks had done?) The Al Tahoe Neighborhood issued 22 depredation permits between 2010 and 2011 for bears breaking into garbage and homes, making life more risky for the Three Bears. The Bears apologized for the break-ins but explained that their food was becoming harder to come by due to climate change and development. Their bear home was surrounded by human homes now making it harder to avoid humans and human garbage was so dang easy to get compared to traveling many miles for limited berries.

The story format is easier to follow and repeat, which is vital in trying to reach your goal(s). Of course, real stories and real facts are much better than made up versions.

Step 3: Choose your Messengers

Depending upon who you are talking to about climate change impacts, it can be useful to have a variety of trusted sources helping you communicate your message. Some audiences may automatically find you trustworthy and credible, while other audiences may feel more comfortable with outside expert presenters from academia, government agencies, or other institutions. Often, the best messenger is someone from the local community who has credibility with a broad audience (doctors, ministers, elected officials, etc.). Research shows that people have a distrust of the media providing information on climate change and have greater trust in scientists or people they perceive as being like themselves.¹³⁶

Always consider if you have local, trustworthy, community-known experts you can draw from to help in your educational outreach. An easy way to start is by asking who your target audience already listens to with respect and regularly? Is it the rabbi? Is it the fire chief? Is it the President of the Rotary Club? Is it the Forest Service ranger? Finding and engaging these existing trusted sources in the community will increase the credibility of your message.

Step 4: Distribute the Messages/Stories, and Engage Your Target Audience

Once you've chosen your messengers, determine then how to distribute your message and engage your target audience. There are many ways to effectively communicate your message depending on your target audience, organizational budget, and type of message(s).

Your first step should be to look at how your target audience already communicates in their community. For example, parishioners hear sermons, get messages from the synagogue bulletin board, and read the emailed church newsletter. Neighbors hear speakers at the annual block party, get leaflets on their doorstep, and talk to each other door to door. Anglers get information at the local fishing supply shop, read ads in angling magazines, and talk to other anglers at fishing hot spots. Do not assume if your target audience is the local fire safe council that a paid ad in the New York Times is the best and most cost-effective means to reach your fire safe council decision-making audience.

Here are a few examples for general community outreach:

- People crave personal interaction when discussing issues that are technical and data driven. Verbal presentations or conversations help people process and understand the information.
- E-mail is probably the single most valuable outreach tool because of its low cost and potential for spreading information by peer-to-peer contact. The key is having an updated distribution list. Local groups, churches, and businesses often have email distribution lists that they may share.
- Use free media when possible for your target audience. Free media includes letters to the editor, opinion-editorials (op-eds), and guest spots on radio and television programs. You can also do news releases and news conferences to gain coverage in daily and weekly newspapers, radio news, and television news. See *Further Resources* at the end of this chapter.
- Even in the Internet age a leaflet, poster, or display is still an important way of explaining your work. Take note of where you see other community communications posted or displayed.
- Postcards are an inexpensive way to expose your target audience to an issue immediately and provide a link to a website for more information. People receive fewer hard copy mailings than email, and for particular audiences, it may be a communication medium they read more thoroughly.

Remember, have the trusted messengers be the ones delivering the message in the format you've chosen. So if physicians are on your list as trusted messenger, is there a physician who will do a presentation to your city council using the effective messages you've chosen? Maybe they don't feel comfortable giving a city council presentation but are happy to author the opinion editorial or will sign a letter with other physicians to be delivered to the city council. Choose actions that your messengers will feel comfortable doing.

Step 5: Evaluate Success

Once you have chosen messages, stories, messengers, and the mechanism to distribute the message, determine metrics that will help you know your communication strategy is working. Here is where you should consider your desired behavior or action of the decision maker. For each message/messenger/distribution strategy, determine measurements of success.

For example, pretend you decided that you are asking a city council member to adopt an emission reduction action. You know that he listens to his minister, and therefore you ask the minister to write an opinion editorial discussing how emission reduction is stewarding God's creation. In this instance, is the definition of success:

- that the opinion editorial was written and submitted? What if it doesn't include your key messages or story?
- that the opinion editorial was printed? What if it is printed on a holiday when most people don't read the paper?
- that a copy of the opinion editorial was mailed to the city council member? What if it is still not read?
- that the minister called the city council office and asked the city council member what he thought about the editorial and how was he going to vote on the upcoming measure?
- that the city council member reported to his minister he was voting for the emission reduction ordinance?

If the city council member reports he is not supporting the ordinance, what were the city council member's concerns, questions, or objections to the ordinance? Consider the response a new opening and an opportunity to re-engage and adjust your strategy. With this information, are there new messages, new messengers, and new distribution strategies you want to use to address those concerns, questions, and objections?

The key is to evaluate:

- Did your messages come out clearly in your distribution mechanism? You can often evaluate this yourself.
- Did the distribution mechanism reach the target audience? What portion of the target audience? You may have to do a survey to determine if they saw it. It may be easy to find out about one person, but requires more resources for larger target audiences.
- Did your messages or story influence your decision maker? This requires someone to ask the decision maker what he or she thought of the communication, and again a trusted relationship with the decision maker can get this information more readily.
- Did the targeted audience give you your goal as a result of using a particular messaging strategy?

In summary, effective communication is an essential strategy for overcoming perceived barriers and getting local governments, organizations, and individuals to take action on the pressing issue of climate change. This chapter showed how to develop a successful communication

framework, craft effective climate change messages and stories, and disseminate your messages to your target audiences through trustworthy messengers. Below are further resources to help you inform and motivate your target audiences to achieve your determined goals.

Further Resources on Communicating Climate Change

American Psychology Association. “*Psychology and Global Climate Change: addressing a multi-faceted phenomenon and set of challenges.*” 2009. This document discusses the varying psychological elements associated with climate change including barriers to action and how people perceive risk associated with climate change. It offers important insight into how people address the issue of climate change that can then be interpreted into lessons on messaging.

Climate Outreach and Information Network. “*How to Engage your Community and Communicate about Climate Change*”. 2010. This article offers an easy-to-read guide on how to create an effective climate change message that will educate your target audience. It discusses the things you should and should not do when creating and disseminating your message, types of effective messengers, and how to deal with those that refuse to listen.

ICLEI. “*Preparing for Climate Change: A Guidebook for Local, Regional and State Governments.*” King County, Washington. 2007. This guidebook provides local, regional, and state governments with a stepwise process to addressing climate change impacts and identifying and implementing adaptation strategies. The guide also includes two useful chapters (3 and 5) that outline the case for why governments should prepare for climate change and how to build and maintain support for these actions through communication and messaging.

smartMeme. A non-profit organization whose mission is to build movements and amplify the impacts of grassroots organizing with new strategy and training resources, values-based communications, collaborations, and meme campaigning. Their website has useful resources including strategy tools, analyses, and case studies to help social change campaigns be more effective. <http://www.smartmeme.org/section.php?id=86>.

The United States Environmental Protection Agency. “*Getting in Step: A Guide for Conducting Watershed Outreach Campaigns.*” 2003. This document is an excellent source that offers a step-by-step process for how to develop an educational outreach campaign. It provides specifics for identifying target audiences, crafting efficient, effective messages, and potential distribution methods for messages. It offers easy to use checklists for each step to ensure you have covered important processes and procedures. Though designed for watershed outreach, the overarching lessons and take away messages are extremely applicable to climate change messaging.

Chapter 7: Conclusion

We hope this toolkit is a valuable resource for everyone involved in planning and implementing projects in the Sierra Nevada. The world's climate is changing, and the magnitude and speed in which these predicted changes are occurring can be overwhelming and discouraging. Yet there has never been a greater motivation for our culture to change current wasteful practices, to understand and respect how nature works, and to shape our activities to be in balance with natural systems. Within these climate challenges are opportunities to make our communities and local economies more sustainable and our natural resources more resilient. Creating a secure future requires preventative action and preparedness.

Reducing Emissions and Adapting to Climate Change Should be Addressed Simultaneously

It is not enough to just address adaptation without reducing our emissions. It is necessary to both combat the cause of climate change through greenhouse gas (GHG) reduction measures as well as adapt for future climate scenarios in order to build and protect resilient, healthy communities and ecosystems. If we only focus on reductions, we will be vastly unprepared economically, environmentally, and socially to combat the unavoidable impacts of climate change that are already set in motion. If we only focus on adaptation strategies, we will never address the heart of the climate change problem and will continue to alter our earth's climate resulting in catastrophic changes. By addressing adaptation and emission reduction strategies in a coordinated and efficient manner, planners, resource managers, policymakers, and community members can succeed in protecting our unique Sierra historical, cultural, environmental, and economic heritage.

Many Resources are Available to Expand on this Toolkit

We hope the information and resources presented in this toolkit empower you to take a lead in your local resource planning efforts. The next Appendix provides current resources to expand on this Toolkit's review of the science and impacts of climate change, frameworks for reducing emissions and adapting to impacts, and communication tools for leading on these issues.

Beyond this toolkit, you can track new developments, find out about potential funding opportunities and get other useful tools by:

- Signing up for the Sierra Nevada Alliance's monthly Climate Change electronic newsletters by emailing info@sierranevadaalliance.org with Subject: Subscribe Climate E-News. Include your name, affiliation (optional), phone number and email address.
- Checking out our website: www.sierranevadaalliance.org.

Please Send us Comments and New Resources

This is the third edition of the Sierra Climate Change Toolkit, and we welcome your input to make our website and program resources even more useful and relevant. Please send us your comments on what is helpful or what could be improved. Forward tools, names of presenters, messages, and any tips or information you think would be good for others to know about when planning for climate change. Contact the Sierra Nevada Alliance at:

Email: info@sierranevadaalliance.org

Web: www.sierranevadaalliance.org

Phone: 530.542.4546

Address: P.O. Box 7989, South Lake Tahoe, CA 96158

Our Responsibility is to Create a Sustainable Future for Coming Generations

The economic, social, and political conditions are ripe for innovative and creative changes that will shape the future survival and sustainability of rural and urban communities across the country. Sierra communities have the opportunity to become forerunners in rural community and resource planning for climate change and could provide practical models applicable to other rural regions throughout the nation. Planning now on how to adapt and reduce emissions is critical; and acting with foresight allows us to create innovative solutions that benefit our communities and wildlands.

Future generations rely on us, and addressing climate change is our responsibility. We can leave the Sierra with a legacy of clean drinking water, healthy forests and woodlands, stable fish and wildlife populations, and vibrant local communities and economies. The future is ours to create.



"Lake Tahoe" ©ElizabethCarmel.com

Appendix A: Further Resources

Climate change is an encompassing issue whose far-reaching effects are already being seen. For this reason, new resources and websites are becoming available nearly every day. The Sierra Nevada Alliance has compiled a select list of resources (not including those mentioned earlier in the Toolkit) that we found useful and informative in creating this Sierra Climate Change Toolkit. We will frequently update and expand this list on our website: <http://www.sierranevadaalliance.org>. If you know of a great resource that you do not see listed here, please send it our way. We appreciate a helping hand in tracking down valuable materials.

The following resources are organized into these categories:

- Research, Reports, Programs, and Resource Websites
- Models and Scenario Tools
- Case Studies
- Webinars
- Funding Resources

Research, Reports, Programs, and Resource Websites:

International

The Intergovernmental Panel on Climate Change: Fourth Assessment Report

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations to assess scientific, technical, and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and greenhouse gas emission reduction. It is currently starting work on its Fifth Assessment Report (AR 5). The IPCC website has great informational reports and graphics about global climate change, including the Fourth Assessment Report, written by the world's leading scientists, which demonstrates climate change is happening now, shows what future impacts may be, explains the potential to adapt to these changes, and explores costs, policies, and technologies associated with reducing greenhouse gas (GHG) emissions.

<http://www.ipcc.ch>

National

Interfaith Power & Light

Interfaith Power & Light is an interfaith ministry devoted to deepening the connection between ecology and faith and mobilizing a national religious response to global warming while promoting renewable energy, energy efficiency, and conservation.

<http://interfaithpowerandlight.org/>

National Research Council of the National Academies: America's Climate Choices

This website has online booklets and reports that discuss the issues associated with global climate change, including the scientific and technological challenges involved. It also provides suggestions regarding actions and strategies the nation can take to respond to climate change.

<http://americasclimatechoices.org>

Natural Resources Defense Council (NRDC)

NRDC is an environmental non-profit organization that works to solve the world's most pressing environmental issues including climate change. Their website contains in-depth reports, up-to-the-minute articles, and information on U.S. clean energy and climate legislation, climate solutions, green jobs, and more.

<http://www.nrdc.org/globalWarming/default.asp>

Union of Concerned Scientists

The Union of Concerned Scientists, a science-based non-profit organization that combines citizen action with independent scientific research to develop workable solutions to issues like climate change, has a comprehensive website with a wealth of understandable information about climate change.

http://www.ucsusa.org/global_warming/

United States Environmental Protection Agency (EPA) Climate Change Website

The EPA's Climate Change site offers a wealth of comprehensive and accessible information on climate change for communities, individuals, business, states, and localities. Topics covered include climate change indicators, climate change science, GHG emissions, climate economics, EPA regulatory initiatives for GHG emissions, U.S. climate policy, health and environmental effects, and what steps individuals can take to reduce their emissions.

<http://epa.gov/climatechange/>

United States Forest Service Climate Change Resource Center

This reference website, a joint project of the US Forest Service Research Stations and the Environmental Threat Assessment Centers, contains information and tools to assist resource managers in addressing climate change. Resources include climate basics, case studies, scientific studies, webinars, and tools (such as mapping and modeling tools).

<http://www.fs.fed.us/ccrc/>

United States Global Change Research Program Website

The U.S. Global Change Research Program coordinates thirteen federal departments and agencies to research and inform the federal government on changes in the global environment and their implications for society. This informative website contains the latest on what each of these federal partners is working on, as well as scientific reports and assessments on the impacts of climate change to the United States.

<http://www.globalchange.gov/>

California and the West

California Climate Action Team Reports to the Governor and Legislature

The final 2009 Climate Action Team (CAT) Biennial Report was published in April 2010. This updated report contains and provides a comprehensive review and analysis of climate change modeling for California.

<http://www.energy.ca.gov/2010publications/CAT-1000-2010-004/CAT-1000-2010-004-ES.PDF>

California Climate Change Portal

An invaluable website, the California Climate Change Portal, leads to information on all the work being done on climate change by the State of California. This includes reports and research on topics such as wildfires, health impacts, water supply and agriculture among many others.

<http://www.climatechange.ca.gov/>

California Department of Water Resources Climate Change Website & Clearinghouse

An up-to-date resource website and reference guide (Clearinghouse), these resources focus on the impacts of climate change on California water resources, the actions that are being taken to address them, and further information of use to water resource managers.

Website:

<http://www.water.ca.gov/climatechange/>

Clearinghouse:

<http://www.water.ca.gov/irwm/docs/ResourcesLinks/IRWM%20Climate%20Change%20Document%20ClearinghouseFINAL.pdf>

California Public Interest Energy Research (PIER) Program Research Papers

The California Energy Commission's PIER Program helps improve the quality of life in California by studying the effects of climate change on many different aspects of the environment. This web portal contains a database of research papers they have funded that address various aspects of climate change.

<http://www.climatechange.ca.gov/publications/cat/index.html>

CIRMOUNT: Consortium for Integrated Climate Research in Western Mountains

The Consortium for Integrated Climate Research in Western Mountains (CIRMOUNT) is a collaborative, interdisciplinary consortium that brings together researchers from across the West and across disciplines to understand climate-driven change and develop responses to those changes. The website contains information, publications, reports, and presentations.

<http://www.fs.fed.us/psw/cirmount>

Climate Change News Digest

An online compilation of the latest news articles about climate change and as well as other resources.

<http://www.climatechangenews.org/>

GEOS Institute

The GEOS Institute is a non-profit organization whose mission is to help both human and natural communities predict and prepare for a changing climate using the best available science. ClimateWise® is the GEOS Institute's nonprofit scientific consulting firm, which works with communities to identify current and predicted climate change impacts in their region and to develop specific actions to prepare for those impacts. The ClimateWise® process has been conducted in communities in California, Oregon, and Montana.

<http://www.geosinstitute.org>

"In Hot Water: Water Management Strategies to Weather Global Warming"

Authored by Barry Nelson, Monty Schmitt, Robert Wilkinson, Ronnie Cohen, and Noushin Ketabi for NRDC in July 2007, this publication analyzes water management tools and makes recommendations to meet the challenges of global warming. The reading also contains a concise summary of water-related problems and solutions to deal with them.

<http://www.nrdc.org/globalwarming/hotwater/contents.asp>

“Land Use, Climate Change & Public Health Issue Brief: Improving public health and combating climate change through sustainable land use and transportation planning”

This briefing paper, put together by the American Lung Association in Spring 2010, demonstrates the important connection between land use, climate change, and public health, as well as the significance of SB 375 to addressing that nexus. The paper also presents smart land use and transportation policies that would create healthier communities as well as reduce GHG emissions.

http://www.climateplanca.org/ALAC_SB_375_Briefing.pdf

“Local Government Toolkit”

Cool California’s Local Government Toolkit is a comprehensive introduction for cities and counties to save money, reduce their GHG emissions, find financial resources to take further action, access tools such as carbon calculators and model scenarios, start a climate action plan, and find out how other California local governments have taken successful action.

<http://www.coolcalifornia.org/local-government>

Model Forest Policy Program

A national non-profit organization, the Model Forest Policy Program works to protect forest resources and promote sustainable forestry practices that protect forests, water resources, and local communities, as well as provide climate benefits. The organization recently started a training organization called the Climate Solutions University, which has so far assisted six communities in developing a local adaptation plan to address forest, land, water, climate change, and community issues. To participate in the training or to find out more about their other resources and opportunities, check out their website.

<http://www.mfpp.org/>

“Model Policies for Greenhouse Gases in General Plans”

The California Air Pollution Control Officers Association (CAPCOA), an Association of Air Pollution Control Officers, put together this very useful resource in June 2009 for cities and counties to address emission reduction in General Plans. It covers how and where to include GHG reduction policies in existing General Plan elements, existing California climate legislation and regulations, how to create a new GHG element if desired, an evaluation worksheet to review policies’ applicability, plans that have incorporated model policy, a menu of sample policy language to include in the General Plan, and more technical resources.

<http://www.epa.gov/region9/climatechange/pdfs/CAPCOA-Model-Policies.pdf>

“On The Edge: Protecting California’s Fish and Waterfowl from Global Warming”

This 2008 report produced by the National Wildlife Federation and the Planning & Conservation League Foundation provides a summary of scientific research that looks at how global warming is causing irreversible damage on habitats of fish and waterfowl and suggests a plan of action to prevent further harm to California’s fish and waterfowl.

<http://www.pcl.org/projects/OnTheEdge.pdf>

WeADAPT

This wiki site allows users to create a free account, customize a homepage to get updates on topics related to climate change that interest you, and share adaptation news, projects, tools, and more with other users.

<http://www.weadapt.org>

“Windfall for All: How Connected, Convenient Neighborhoods Can Protect Our Climate and Safeguard California’s Economy”

Transform, a non-profit organization that advocates for public transportation and walkable communities in the Bay Area, published this resource in 2009. The document highlights the money savings, emission reduction, job creation, and other benefits of creating more efficient neighborhoods, enhancing public transportation, and supporting smart growth strategies throughout California. The report also includes case studies regarding what California regions, counties, cities, and others are already doing to achieve these goals and reap these benefits.

<http://transformca.org/windfall-for-all>

Models and Scenario Tools

CalAdapt

CalAdapt is an exploratory project of the California Energy Commission, Google.org, and the Stockholm Environment Institute, which uses a Google Earth-based platform to demonstrate changes in climate, sea level rise, wildfire frequency, and snowpack projections at the local level. These visual tools can be used by decision-makers and the general public to better understand the regional and local implications of climate change and spur action on this important issue. The project also plans to expand to provide additional data sets, reports, and information for natural resource managers.

<http://www.climatechange.ca.gov/visualization/index.html>

UK Climate Impacts Programme Adaptation Wizard

The UK Climate Impacts Programme Adaptation Wizard is a web-based adaptation tool, taking users through a five step adaptation planning process that reflect the Alliance’s adaptation principles. Although the project is based on the UK, it is generic enough for United States audiences and provides an understandable framework for developing an adaptation plan.

<http://www.ukcip.org.uk>

U.S. EPA Climate Ready Water Utilities Program

A program of the U.S. EPA, Climate Ready Water Utilities (CRWU) develops tools and resources for water managers to prepare for the impacts of climate change. On the CRWU website you can find the following useful reports and tools: 1) Link to the CWRU Working Group which is identifying needs for more climate change tools, trainings, and resources for water utilities, as well as the best mechanisms for getting emission reduction and adaptation strategies adopted by water utilities; 2) Link to the Climate Resilience and Assessment Tool (CREAT), a

free software program that guides water resource managers in evaluating potential risks due to climate change and in developing adaption options to address those risks; and 3) Link to the Climate Ready Water Utilities Toolbox, a searchable database that includes many resources on climate science, emission reduction, and adaptation planning such as reports, grant opportunities, tools, and training sessions.

<http://water.epa.gov/infrastructure/watersecurity/climate/index.cfm>

Case Studies

City of Aspen Canary Initiative

In March of 2005, the City of Aspen adopted a plan to aggressively begin reducing global warming emissions. This initiative is a great example of the sort of action a city can take to reduce global warming pollution; inform the public about impacts from and solutions to global warming; and to advocate for action on a regional, state, and national level.

<http://www.aspenglobalwarming.com>

Climate Adaptation Knowledge Exchange (CAKE)

CAKE, a joint project of Island Press and EcoAdapt, is an interactive website that seeks to connect users with case studies, advice, tools, training opportunities, and information on climate change and climate change adaptation. In addition, by becoming a registered user, you can share and upload your own case studies or examples.

<http://www.cakex.org>

Local Government Commission Case Studies

This webpage of Local Government Commission, a non-profit membership organization, provides case studies of cities and counties addressing climate change through plans, programs, and other initiatives, as well as a thorough list of online climate change resources.

http://www.lgc.org/freepub/climatechange/case_studies.html

Sierra Nevada Alliance Climate Change Case Studies

The Sierra Nevada Alliance has published three editions of case studies, highlighting how resource planners have addressed climate change emission reduction and adaptation in the Sierra and other regions. To see these case studies and future case studies produced by the Sierra Nevada Alliance, check out our Regional Climate Change Program Blog.

<http://snalliance.wordpress.com/category/regional-climate-change/>

Webinars

Safeguarding Wildlife from Climate Change

The U.S. Fish & Wildlife Service (USFWS) and the National Wildlife Federation (NWF) have developed a series of web conferences to help conservation professionals and others stay up-

to-date with current developments to help safeguard fish and wildlife resources in the face of climate change. You can sign up to see future webinars through the link below as well as watch archived videos.

http://training.fws.gov/CSP/Course_descriptions/CSP3902.htm

U.S. EPA Watershed Academy Webcast Seminars

The U.S. EPA Watershed Academy offers free online webcast seminars that are designed for local watershed organizations, water resource managers, and other water stakeholders. The webcasts cover many topics including climate change.

http://water.epa.gov/learn/training/wacademy/webcasts_index.cfm#change

Funding Resources

Cool California Financial Resources

The Cool California website has a list of financial resources for local governments that is categorized by issue (such as renewable energy, land use, climate action planning, etc.). They also have a list of rebates and incentives opportunities for small businesses. Both these lists are updated regularly, and users may submit new financial resources for posting on the website.

<http://www.coolcalifornia.org/article/financial-resources>

<http://www.coolcalifornia.org/small-business-financial-resources>

Foundation Center

The Foundation Center is a national non-profit service organization that maintains a useful database on U.S. grantmakers and grants that is useful for doing research on potential foundation funding opportunities. You can sign up for alerts when new requests for proposals are distributed or to get the latest funding news. They also have interesting news and reports regarding foundation funding in the U.S., including the article (link below) that lists the biggest private foundation funders of climate change work in the U.S.

<http://foundationcenter.org/>

http://www.foundationcenter.org/gainknowledge/research/pdf/researchadvisory_climate.pdf

Sierra Nevada Conservancy Current Funding Opportunities Website

Beyond their own grant program, the Sierra Nevada Conservancy, a state agency, also provides assistance through their Current Funding Opportunities Website. The site is updated regularly with new opportunities (private foundation grants, government grants, and others), workshops, and other resources applicable to Sierra stakeholders. You can check their website regularly for new grant opportunities or sign up for their email alert list.

http://www.sierranevadaconservancy.ca.gov/other_current_funding.html

Endnotes

- 1 Susan Moser, et al., *The Future is Now: An Update on Climate Change Science Impacts and Response Options for California*, (California Energy Commission, May 2009), available from: <http://www.energy.ca.gov/2008publications/CEC-500-2008-071/CEC-500-2008-071.PDF>.
- 2 John Leslie, "NOAA Reports 2006 Warmest Year on Record for U.S., General Warming Trend, El Nino Contribute to Milder Winter Temps," National Oceanic and Atmospheric Administration, 9 January 2007, available from: <http://www.noaaews.noaa.gov/stories2007/s2772.htm>.
- 3 John Leslie, "Global Temperatures Well Above Average; Slightly Above-Average for U.S.," National Oceanic and Atmospheric Administration, 8 December 2009, accessed online 16 November 2010, available from: http://www.noaaews.noaa.gov/stories2009/20091208_globalstats.html.
- 4 IPCC, *Summary for Policymakers in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge, United Kingdom and New York, NY: Cambridge University Press, 2007), available from: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>.
- 5 IPCC, *Summary for Policymakers in: Climate Change 2001: IPCC Third Assessment Report*, (2001), available from: http://www.grida.no/climate/ipcc_tar/vol4/english/pdf/spm.pdf.
- 6 Kerry Emmanuel, "Increasing Destructiveness of Tropical Cyclones Over the Past 30 Years," *Nature* 436(2005): 686-688.
- 7 IPCC, *Summary for Policymakers in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge, United Kingdom and New York, NY: Cambridge University Press, 2007), available from: <http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>.
- 8 Ibid.
- 9 Janet Larson, "Setting the Record Straight: More than 52,000 Europeans Died from Heat in Summer 2003," (Earth Policy Institute, 2006), accessed online 16 June 2010, available from: http://www.earth-policy.org/index.php?/plan_b_updates/2006/update56.
- 10 IPCC, *Summary for Policymakers in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.
- 11 IPCC, *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Geneva, Switzerland: IPCC, 2007), available from: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.
- 12 IPCC, *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge, United Kingdom and New York, NY: Cambridge University Press, 2001), available from: http://www.grida.no/publications/other/ipcc_tar/.
- 13 IPCC, *Summary for Policymakers in: Climate Change 2001: IPCC Third Assessment Report*.
- 14 IPCC, *Summary for Policymakers in: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.
- 15 Stefan Lovgren, "Warming to Cause Catastrophic Rise in Sea Level?," *National Geographic News*, updated 26 April 2004, accessed 23 Nov 2010, available from: <http://www.usc.edu/org/cosee-west/glaciers/CatastrophicRiseArticle.pdf>.

- 16 Climate Action Team, *2009 Climate Action Team Biennial Report to the Governor and Legislature*, (Sacramento, CA: State of California, 2010), 1.10, available from: <http://www.energy.ca.gov/2010publications/CAT-1000-2010-004/CAT-1000-2010-004.PDF>.
- 17 IPCC, *Climate Change 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Cambridge, United Kingdom: Cambridge University Press, 2007), available from: available from: http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg2_report_impacts_adaptation_and_vulnerability.htm.
U.S. Environmental Protection Agency, *Coastal Zones and Sea Level Rise*, updated 19 August 2010, available from: <http://www.epa.gov/climatechange/effects/coastal/index.html>.
- 18 IPCC, *Climate Change 2007: Impacts, Adaptation and Vulnerability Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*.
U.S. Environmental Protection Agency, *Coastal Zones and Sea Level Rise*.
- 19 The World Bank, *World Development Report 2010: Development and Climate Change* (Washington, DC: World Bank, 2010), 124, available from: <http://siteresources.worldbank.org/INTWDR2010/Resources/5287678-1226014527953/WDR10-Full-Text.pdf>.
- 20 UNEP, *Global Environment Outlook 2000*, (Nairobi, Kenya: United Nations Environment Program, 1999), available from: <http://www.unep.org/geo/GE02000/english/Index.htm>.
- 21 Alison Stattersfield, et al., *Endemic Bird Areas of the World: Priorities for Biodiversity Conservation*, BirdLife Conservation Series No. 7, (Cambridge, United Kingdom: BirdLife International, 1998).
- 22 Camille Parmesan and Hector Galbraith, *Observed Impacts of Global Climate Change in the U.S.*, (Arlington, VA: Pew Center on Global Climate Change, 2004), available from: http://www.pewclimate.org/docUploads/final_ObsImpact.pdf.
- 23 Ibid.
- 24 U.S. Global Change Research Program, *Global Climate Change Impacts in the United States*, (New York, NY: Cambridge University Press, 2009), accessed 17 Nov 2010, available from: <http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>.
- 25 Ibid, 27.
- 26 Ibid, 80.
- 27 Earth Gauge, *Climate Change and Ecosystems of the Far North*, available from: http://new.earthgauge.net/wp-content/CF_Ecosystems%20of%20the%20Far%20North.pdf.
- 28 U.S. Geological Survey, *Retreat of Glaciers in Glacier National Park*, updated June 2010, available from: http://www.nrm-sc.usgs.gov/research/glacier_retreat.htm.
- 29 Myrna Hall and Daniel Fagre, "Modeled Climate-induced Glacier Change in Glacier National Park, 1850-2100," *BioScience* 53, 2 (2003): 131-140.
- 30 U.S. Global Change Research Program, 38.
- 31 Earth Gauge.
- 32 Yereth Rosen, "Climate Change and Urban Sprawl Alter Iditarod Race," *Reuters*, 28 February 2008, available from: <http://www.enn.com/ecosystems/article/31967>.
- 33 Yereth Rosen, "Alaska's Climate Refugees Build New Village," *Reuters*, 23 February 2010, available from: <http://www.reuters.com/article/idUSN2221852020100223?type=marketsNews>.
- 34 IPCC, *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change*.
- 35 Michelle Nijhuis, "The Ghosts of Yosemite," *High Country News*, 17 October 2005, available from: <http://www.hcn.org/issues/308/15837>.

- 36 Ibid.
- 37 U.S. Global Change Research Program, 80.
- 38 Ibid, 84.
- 39 Climate Action Team, 1.6.
- 40 California Department of Water Resources, *Possible Impacts of Climate Change to California's Water Supply*, (2009), available from: http://www.water.ca.gov/climatechange/docs/climate_change_impacts_summary_sheets.pdf.
- 41 Ibid.
- 42 Katharine Hayhoe, et al., "Emissions Pathways, Climate Change, and Impacts on California," *Proceedings of the National Academy of Sciences* 101, 34 (2004): 12422-12427.
- 43 A. Westerling, et al., "Warming and Earlier Spring Increase Western U.S. Forest Wildfire Activity," *Science* 313, 5789(2006): 940-943, available from: <http://www.sciencemag.org/content/313/5789/940.abstract>.
- 44 Michael Dettinger and Daniel Cayan, "Large-Scale Atmospheric Forcing of Recent Trends toward Early Snowmelt Runoff in California," *Journal of Climate* 8 (1995): 606-623.
- 45 Ibid.
- 46 Hayhoe, et al.
- 47 O. Hadley, et al., "Measured Black Carbon Deposition on the Sierra Nevada Snow Pack and Implication for Snow Pack Retreat," *Atmos. Chem. Phys.* 10, (2010): 7505–7513, available from: <http://www.atmos-chem-phys.org/10/7505/2010/acp-10-7505-2010.pdf>.
- 48 Hayhoe, et al.
- 49 Ibid.
- 50 Ibid.
- 51 Usha McFarling, "Survey Finds Sierra Nevada Glaciers Are in Rapid Retreat," 12 October 2003, available from: <http://www.calclim.dri.edu/califglaciers.html> .
- 52 Amy Luers, et al., *Our Changing Climate, Assessing the Risks to California: A Summary Report from the California Climate Change Center*, (California Energy Commission, 2006), available from: <http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF>.
- 53 Donald Grayson, "A Brief History of Great Basin Pikas," *Journal of Biogeography* 32, 12 (2005): 2103–2111.
Constance Millar and Robert Westfall, "Distribution and Climatic Relationships of the American Pika (*Ochotona princeps*) in the Sierra Nevada and Western Great Basin, U.S.A.; Periglacial Landforms as Refugia in Warming Climates," *Arctic, Antarctic, and Alpine Research* 42, 1 (2010): 76-88.
- 54 U.S. Global Change Research Program, 132.
- 55 Ibid, 80.
- 56 "Sierra Nevada Birds Move In Response To Warmer, Wetter Climate," *ScienceDaily*, 4 October 2009, accessed 18 November 2010, available from: <http://www.sciencedaily.com/releases/2009/09/090914151625.htm>.
- 57 "Climate Change Effects On Imperiled Sierra Frog Examined," *ScienceDaily*, 30 December 2008, accessed 18 November 2010, available from: <http://www.sciencedaily.com/releases/2008/12/081211093559.htm>.
- 58 Constance Millar, et al., "Elevational Gradients and Differential Recruitment of Limber Pine (*Pinus flexilis*) and Bristlecone Pine (*Pinus longaeva*); White Mountains, California, USA," USDA Forest Service, Sierra Nevada Research Center, Albany, CA, 2006, available from: http://www.fs.fed.us/psw/publications/millar/posters/millar_et_al_poster_agu2006.pdf.

- 59 Phillip Van Mantgem, "Tree Deaths in California's Sierra Nevada Increase as Temperatures Rise," USGS, Western Ecological Research Center, August 2007, available from: <http://www.werc.usgs.gov/fileHandler.ashx?File=/Lists/Products/Attachments/3494/vanmantgempbaug2007.pdf>.
- 60 Center for Biological Diversity, *Fish That Need Us to Get to 350*, available from: http://www.biologicaldiversity.org/programs/climate_law_institute/350_reasons/fish.shtml.
- 61 "President Obama Sets Greenhouse Gas Emissions Reduction Targets for Federal Operations," The White House, Office of the Press Secretary, 29 January 2010, available from: <http://www.whitehouse.gov/the-press-office/president-obama-sets-greenhouse-gas-emissions-reduction-target-federal-operations>.
- 62 Nancy Sutley, "Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions," Executive Office of the President of the United States, Council on Environmental Quality, 18 February 2010, available from: <http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100218-nepa-consideration-effects-ghg-draft-guidance.pdf/>.
- 63 IPCC, *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, (Geneva, Switzerland: IPCC, 2007), available from: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.
- 64 California Air Resources Board, "AB 32 Climate Change Scoping Plan Implementation Update," 22 April 2010, available from: <http://www.arb.ca.gov/board/books/2010/042110/10-4-1pres.pdf>.
- California Air Resources Board, *Early Action Items*, available from: <http://www.arb.ca.gov/cc/ccea/ccea.htm>.
- 65 Arnold Schwarzenegger, *Executive Order S-14-08*, State of California, Office of the Governor, 17 November 2008, available from: <http://gov.ca.gov/executive-order/11072/>.
- 66 ClimatePlan, *SB 375 Fact Sheet: Maximizing Economic Growth*, available from: http://www.climateplanca.org/SB375_econ_fact_sheet.pdf.
- 67 Climate Leadership Initiative, *Curbing and Preparing for Global Climate Change: Handbook for Rural Governments in the Pacific Northwest*, (March 2007), available from: <http://www.theresourceinnovationgroup.org/storage/PNWRuralGovtHndbk0322.pdf>.
- 68 Council on Environmental Quality, *New Proposed NEPA Guidance and Steps to Modernize and Reinvigorate NEPA*, available from: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa>.
- 69 Council on Environmental Quality, *A Citizen's Guide to the NEPA: Having Your Voice Heard*, (December 2007), available from: http://ceq.hss.doe.gov/nepa/Citizens_Guide_Dec07.pdf.
- 70 U.S. Environmental Protection Agency, *EPA Presents the National Building Competition 2010 Competition Summary*, (2010), available from: http://www.energystar.gov/ia/business/buildingcontest/NBC_report_final.pdf.
- 71 According to a 2009 study, homes that are located in more walkable neighborhoods command a premium of about \$4,000 to \$34,000 over homes in neighborhoods with just average walkability.
- Joe Cortright, *Walking the Walk: How Walkability Raises Home Values in U.S. Cities*, (CEOs for Cities, August 2009), available from: <http://www.climateplanca.org/WalkingtheWalk.pdf>.
- 72 U.S. Environmental Protection Agency, *The Transportation and Environmental Impacts of Infill versus Greenfield Development: A Comparative Case Study Analysis*, (1 October 2009), available from: http://www.epa.gov/smartgrowth/pdf/infill_greenfield.pdf.
- 73 Clark Anderson and Patricia Hickson, *Planning for Water-Wise Development in the Sierra: A Water and Land Use Policy Guide*, (South Lake Tahoe, CA: Sierra Nevada Alliance, 2008), 54, available from: http://www.sierranevadaalliance.org/publications/db/pics/1218735464_22191.f_pdf.pdf.
- 74 Bevan Griffiths-Sattenspiel, *The Energy Benefits of Low Impact Development and Green Infrastructure*, (River Network, 13 August 2010), available from: <http://www.rivernetwork.org/blog/7/2010/08/13/energy-benefits-low-impact-development-and-green-infrastructure>.

- 75 Noah Garrison, et al., *A Clear Blue Future: How Greening California Cities Can Address Water Resources and Climate Challenges in the 21st Century*, (Natural Resources Defense Council, August 2009), available from: http://www.nrdc.org/water/lid/files/lid_hi.pdf.
- 76 Smart Growth America, *What We Learned from the Stimulus, And How to Use What We Learned to Speed Job Creation in the 2010 Jobs Bill*, available from: <http://www.smartgrowthamerica.org/stimulus2009.html>.
- 77 Gary Klein, et al., *California's Water – Energy Relationship*, (California Energy Commission, November 2005), 1, available from: <http://www.energy.ca.gov/2005publications/CEC-700-2005-011/CEC-700-2005-011-SF.PDF>.
- 78 Community Pulse, *California Water Use*, available from: <http://www.communitypulse.org/california/water-use/>.
- “Interactive Map: Water Use Per Capita in California,” *Sacramento Bee*, updated 4 September 2009, available from: <http://www.sacbee.com/2008/11/26/1431106/interactive-map-water-use-per.html>.
- California Department of Water Resources, et al., *20x2020 Water Conservation Plan*, (February 2009), ix, available from: <http://www.water.ca.gov/wateruseefficiency/sb7/docs/20x2020plan.pdf>.
- 79 Nicholas Stern, “The Economics of Climate Change,” *American Economic Review: Papers & Proceedings* 98, 2(2008): 1-37, available from: <http://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.98.2.1>.
- 80 Peter Gleick, et al., *Waste Not, Want Not: The Potential for Urban Water Conservation in California*, (Oakland, CA: Pacific Institute, November 2003), 33, available from: http://www.pacinst.org/reports/urban_usage/waste_not_want_not_full_report.pdf.
- 81 Ibid, 37.
- 82 Jonas Minton, “Statewide Leak Detection Grant Program Final Report,” California Department of Water Resources, 1988.
- 83 Council on Environmental Quality, *Climate Change Adaptation Task Force*, available from: <http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation>.
- 84 Council on Environmental Quality, *A Citizen's Guide to the NEPA: Having Your Voice Heard*, 1-3.
- 85 Natural Resources Agency, *California Climate Adaptation Strategy*, (Sacramento, CA: State of California, 2009), 82, available from: <http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-F.PDF>.
- California Department of Water Resources, *California Water Plan, Update 2009, Highlights*, (Sacramento, CA: State of California, 2009), 8, available from: http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/highlights_cwp2009_spread.pdf.
- 86 Tim Graham, *Climate Change and Ephemeral Pool Ecosystems: Potholes and Vernal Pools as Potential Indicator Systems*, USGS, updated 4 December 2003, available from: <http://geochange.er.usgs.gov/sw/impacts/biology/vernal/>.
- 87 Center for Biological Diversity, *California Species That Need Us to Get to 350*, available from: http://www.biologicaldiversity.org/programs/climate_law_institute/350_reasons/california.shtml.
- 88 Dettinger and Cayan.
- 89 Hayhoe, et al.
- 90 Further Resources: Completed UWMPs: <ftp://ftp.water.ca.gov/uwmp/completed-plans/>
 EID UWMP: <ftp://ftp.water.ca.gov/uwmp/completed-plans/EIDorado ID/UWMP EID Final.pdf>
 DWR Urban Water Management Planning Program: <http://www.water.ca.gov/urbanwatermanagement/>
 Please contact Dave Todd, dtodd@water.ca.gov, if you would like additional information.

- 91 State Water Resources Control Board, oA – *Federal, State and Local Laws, Policy and Regulation*, updated 3 August 2009, available from: http://www.swrcb.ca.gov/water_issues/programs/nps/encyclopedia/0a_laws_policy.shtml.
- State Water Resources Control Board, *Porter-Cologne Water Quality Control Act*, available from: http://www.swrcb.ca.gov/laws_regulations/docs/portercologne.pdf.
- 92 Friends of the River and the California Hydropower Reform Coalition, *Rivers of Power: A Citizen's Guide to River Restoration through Hydropower Reform*, 5, available from: <http://www.hydroreform.org/sites/www.hydroreform.org/files/Rivers%20of%20Power.pdf>.
- Foothills Water Network, *Hydropower Relicensing*, available from: <http://www.foothillswaternetwork.org/relicensing/index.php>.
- 93 California Department of Water Resources, *California Water Plan, Update 2009, Volume 1: The Strategic Plan, Chapter 7 Implementation Plan*, (Sacramento, CA: State of California, 2009), available from: http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v1c7_impleplan_cwp2009.pdf.
- California Department of Water Resources, *DWR Staff Draft Objectives & Related Actions for Water Plan Update 2009*, (1 July 2008), available from: http://www.waterplan.water.ca.gov/docs/meeting_materials/ac/07.09.08/Draft_Update_2009_Objectives_for_AC_Review_07-01-2008_CLEAN.pdf.
- 94 Three Rivers Levee Improvement Authority, *Feather River Setback Levee, Yuba County, California*, available from: <http://www.watereducation.org/userfiles/NCT09TRLIA2.pdf>.
- Friends of the River, *Beyond Flood Control, Flood Management and River Restoration, The Cosumnes River: A Model*, available from: <http://www.friendsoftheriver.org/fotr/BeyondFloodControl/no9.html>.
- Matt Weiser, "Work to Begin on Setback Levee for Flood-scarred Yuba County," *The Sacramento Bee*, 27 May 2008, available from: http://www.friendsoftheriver.org/site/DocServer/080527_SacBee_StorkYubalevee.pdf?docID=2721.
- Friends of the River, "Levee Setbacks Improve Flood Management," *Headwaters* 20, 1 (2008), available from: http://www.friendsoftheriver.org/site/DocServer/Headwaters_Spring_Summer_2008.pdf?docID=2821.
- River Partners, *Riparian Restoration Plan for the Bear River Setback Levee Project*, (15 December 2005), available from: <http://riverpartners.org/reports-and-articles/BearRiverRestorationPlan.pdf>.
- 95 American Rivers, *Deer Creek Floodplain Restoration*, available from: <http://www.americanrivers.org/our-work/water-supply/storage-flows/deer-creek-floodplain-rest.html>.
- Molly McCluskey, *Deer Creek Floodplain Restoration Project Update*, (8 July 2010), available from: <http://www.americanrivers.org/newsroom/blog/deer-creek-floodplain-restoration-project-update-7-8-2010.html>.
- 96 Southern Sierra Partnership, *Framework for Cooperative Conservation and Climate Adaptation for the Southern Sierra Nevada and Tehachapi Mountains, Volume I*, October 2010, 5, available from: <http://www.cakex.org/sites/default/files/Framework%20Sierra%20Nevada%20Tehachapi%20Mtns.pdf>.
- 97 Southern Sierra Partnership, 90.
- 98 Sierra Nevada Alliance, *Case Studies of Climate Change Adaptation*, (South Lake Tahoe, CA: June 2009), available from: http://www.sierranevadaalliance.org/programs/db/pics/1246986175_25252.f_pdf.pdf.
- 99 Juliet Christian-Smith, et al., *California Farm Water Success Stories*, (Oakland CA: Pacific Institute, March 2010), 1-9, available from: http://www.pacinst.org/reports/success_stories/success_stories.pdf.
- 100 Scott River Water Trust, available from: <http://www.scottwatertrust.org/>.
- 101 State of California, AB 2572, available from: http://www.leginfo.ca.gov/pub/03-04/bill/asm/ab_2551-2600/ab_2572_bill_20040929_chaptered.pdf.

- 102 Pacific Institute, “Water Efficiency”, available from: http://www.pacinst.org/topics/water_and_sustainability/water_efficiency/.
- 103 Pacific Institute, *Water Efficiency and Conservation Can Save One Million Acre Feet of Water Quickly and Cost-Effectively; 6-8 Million Acre Feet by 2020*, available from: http://www.pacinst.org/press_center/press_releases/Million_Acre_Feet_Testimony.html.
- 104 Heather Cooley, et al., *Sustaining California Agriculture in an Uncertain Future*, (Oakland, CA: Pacific Institute, 2009), available from, http://www.pacinst.org/reports/california_agriculture/.
- 105 California Department of Water Resources, *Senate Bill SBx7-7 2009*, available from: <http://www.water.ca.gov/wateruseefficiency/sb7/>.
- 106 California Department of Water Resources, *California Water Plan, Update 2009, Volume 2: Resource Management Strategies*, (Sacramento, CA: State of California, 2009), 23-13, available from: http://www.waterplan.water.ca.gov/docs/cwpu2009/0310final/v2c23_forestmgmt_cwp2009.pdf.
- National Fish and Wildlife Foundation, *Sierra Nevada Meadow Restoration Business Plan*, (2010), 5, available from: http://nfwf.org/Content/ContentFolders/NationalFishandWildlifeFoundation/GrantPrograms/Keystones/WildlifeandHabitat/Sierra_Meadow_Restoration_business_plan.pdf.
- 107 Irving Ranch Water District, *Reward Efficiency. Discourage Waste.*, available from: <http://www.irwd.com/alwayswatersmart/rate-structure.html>.
- 108 Ibid.
- 109 Brett Walton, “U.S. Urban Residents Cut Water Usage; Utilities are Forced to Raise Prices,” Circle of Blue, 19 April 2010, available from: <http://www.circleofblue.org/waternews/2010/world/u-s-urban-residents-cut-water-usage-utilities-are-forced-to-raise-prices/>.
- 110 Ibid.
- 111 Governor’s Office of Planning and Research, *State of California General Plan Guidelines 2003*, (Sacramento, CA: Governor’s Office of Planning and Research, 2003), 133, available from: http://www.opr.ca.gov/planning/publications/General_Plan_Guidelines_2003.pdf.
- Edwin Pattison, *Calaveras County Water Element: Water, Land, Environment, Infrastructure*, presentation at Sierra IRWMP Summit: Integrating Water Management in the Sierra, (Calaveras County Water District, 2009), available from: http://www.sierranevadaalliance.org/programs/db/pics/1256244597_19586.f_pdf.pdf.
- 112 Kerri Timmer, et al., *State of Sierra Waters: A Sierra Nevada Watersheds Index*, (South Lake Tahoe, CA: Sierra Nevada Alliance, 2006), 9, available from: http://www.sierranevadaalliance.org/publications/db/pics/1143036971_22153.f_pdf.pdf.
- 113 Craig Moritz, *Final Report: A Re-survey of the Historic Grinnell-Storer Vertebrate Transect in Yosemite National Park, California*, (Berkeley, CA: University of California, Berkeley, 2007), 31-33, available from: http://mvz.berkeley.edu/Grinnell/pdf/2007_Yosemite_report.pdf.
- 114 Sarah Skikne, et al., *On the Edge: Protecting California’s Fish and Waterfowl from Global Warming*, (National Wildlife Federation and Planning and Conservation League Foundation, 2008), available from: <http://www.pcl.org/projects/OnTheEdge.pdf>.
- 115 Anderson and Hickson, 20.
- 116 Luers, et al.
- 117 Ibid.
- 118 John Battles, et al., *Climate Change Impact on Forest Resources: A report from the California Climate Change Center*, (California Energy Commission, 2006), available from: <http://www.energy.ca.gov/2005publications/CEC-500-2005-193/CEC-500-2005-193-SF.PDF>.



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