



Executive Summary

Observations show that warming of the climate is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases. These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities.

Warming over this century is projected to be considerably greater than over the last century. The global average temperature since 1900 has risen by about 1.5°F. By 2100, it is projected to rise another 2 to 11.5°F. The U.S. average temperature has risen by a comparable amount and is very likely to rise more than the global average over this century, with some variation from place to place. Several factors will determine future temperature increases. Increases at the lower end of this range are more likely if global heat-trapping gas emissions are cut substantially. If emissions continue to rise at or near current rates, temperature increases are more likely to be near the upper end of the range. Volcanic eruptions or other natural variations

could temporarily counteract some of the human-induced warming, slowing the rise in global temperature, but these effects would only last a few years.

Reducing emissions of carbon dioxide would lessen warming over this century and beyond. Sizeable early cuts in emissions would significantly reduce the pace and the overall amount of climate change. Earlier cuts in emissions would have a greater effect in reducing climate change than comparable reductions made later. In addition, reducing emissions of some shorter-lived heat-trapping gases, such as methane, and some types of particles, such as soot, would begin to reduce warming within weeks to decades.

Climate-related changes have already been observed globally and in the United States. These include increases in air and water temperatures, reduced frost days, increased frequency and intensity of heavy downpours, a rise in sea level, and reduced snow cover, glaciers, permafrost, and sea ice. A longer ice-free period on lakes and rivers, lengthening of the growing season, and increased water vapor in the atmosphere have also been observed. Over the past 30 years, temperatures have risen faster in winter than in any other season, with average winter temperatures in the Midwest and northern Great Plains increasing more than 7°F. Some of the changes have been faster than previous assessments had suggested.

These climate-related changes are expected to continue while new ones develop. Likely future changes for the United States and surrounding coastal waters include more intense hurricanes with related increases in wind, rain, and storm surges (but not necessarily an increase in the number of these storms that make landfall), as well as drier conditions in the Southwest and Caribbean. These changes will affect human health, water supply, agriculture, coastal areas, and many other aspects of society and the natural environment.

This report synthesizes information from a wide variety of scientific assessments (see page 7) and recently published research to summarize what is known about the observed and projected consequences of climate change on the United States. It combines analysis of impacts on various sectors



such as energy, water, and transportation at the national level with an assessment of key impacts on specific regions of the United States. For example, sea-level rise will increase risks of erosion, storm surge damage, and flooding for coastal communities, especially in the Southeast and parts of Alaska. Reduced snowpack and earlier snow melt will alter the timing and amount of water supplies, posing significant challenges for water resource management in the West.

Society and ecosystems can adjust to some climatic changes, but this takes time. The projected rapid rate and large amount of climate change over this century will challenge the ability of society and natural systems to adapt. For example, it is difficult and expensive to alter or replace infrastructure designed to last for decades (such as buildings, bridges, roads, airports, reservoirs, and ports) in response to continuous and/or abrupt climate change.

Impacts are expected to become increasingly severe for more people and places as the amount of warming increases. Rapid rates of warming would lead to particularly large impacts on natural ecosystems and the benefits they provide to humanity. Some of the impacts of climate change will be irreversible, such as species extinctions and coastal land lost to rising seas.

Unanticipated impacts of increasing carbon dioxide and climate change have already occurred and more are possible in the future. For example, it has recently been observed that the increase in atmospheric carbon dioxide concentration is causing an increase in ocean acidity. This reduces the ability of corals and other sea life to build shells and skeletons out of calcium carbonate. Additional impacts in the future might stem from unforeseen changes in the climate system, such as major alterations in oceans, ice, or storms; and unexpected consequences of ecological changes, such as massive dislocations of species or pest outbreaks. Unexpected social or economic changes, including major shifts in wealth, technology, or societal priorities would also affect our ability to respond to climate change. Both anticipated and unanticipated impacts become more challenging with increased warming.

Projections of future climate change come from careful analyses of outputs from global climate models run on the world's most advanced computers. The model simulations analyzed in this report used plausible scenarios of human activity that generally lead to further increases in heat-trapping emissions. None of the scenarios used in this report assumes adoption of policies explicitly designed to address climate change. However, the level of emissions varies among scenarios because of differences in assumptions about population, economic activity, choice of energy technologies, and other factors. Scenarios cover a range of emissions of heat-trapping gases, and the associated climate projections illustrate that lower emissions result in less climate change and thus reduced impacts over this century and beyond. Under all scenarios considered in this report, however, relatively large and sustained changes in many aspects of climate are projected by the middle of this century, with even larger changes by the end of this century, especially under higher emissions scenarios.

In projecting future conditions, there is always some level of uncertainty. For example, there is a high degree of confidence in projections that future temperature increases will be greatest in the Arctic and in the middle of continents. For precipitation, there is high confidence in projections of continued increases in the Arctic and sub-Arctic (including Alaska) and decreases in the regions just outside the tropics, but the precise location of the transition between these is less certain. At local to regional scales and on time frames up to a few years, natural climate variations can be relatively large and can temporarily mask the progressive nature of global climate change. However, the science of making skillful projections at these scales has progressed considerably, allowing useful information to be drawn from regional climate studies such as those highlighted in this report.

This report focuses on observed and projected climate change and its impacts on the United States. However, a discussion of these issues would be incomplete without mentioning some of the actions society can take to respond to the climate challenge. The two major categories are "mitigation" and "adaptation." Mitigation refers to options for limiting climate change by, for example, reducing



heat-trapping emissions such as carbon dioxide, methane, nitrous oxide, and halocarbons, or removing some of the heat-trapping gases from the atmosphere. Adaptation refers to changes made to better respond to present or future climatic and other environmental conditions, thereby reducing harm or taking advantage of opportunity. Effective mitigation measures reduce the need for adaptation. Mitigation and adaptation are both essential parts of a comprehensive climate change response strategy.

Carbon dioxide emissions are a primary focus of mitigation strategies. These include improving energy efficiency, using energy sources that do not produce carbon dioxide or produce less of it, capturing and storing carbon dioxide from fossil fuel use, and so on. Choices made about emissions reductions now and over the next few decades will have far-reaching consequences for climate-change impacts. The importance of mitigation is clear in comparisons of impacts resulting from higher versus lower emissions scenarios considered in this report. Over the long term, lower emissions will lessen both the magnitude of climate-change impacts and the rate at which they appear. Smaller climate changes that come more slowly make the adaptation challenge more tractable.

However, no matter how aggressively heat-trapping emissions are reduced, some amount of climate change and resulting impacts will continue due to the effects of gases that have already been released. This is true for several reasons. First, some of these gases are very long-lived and the levels of atmospheric heat-trapping gases will remain elevated for hundreds of years or more. Second, the Earth's vast oceans have absorbed much of the heat added to the climate system due to the increase in heat-trapping gases, and will retain that heat for many decades. In addition, the factors that determine emissions, such as energy-supply systems, cannot be changed overnight. Consequently, there is also a need for adaptation.

Adaptation can include a wide range of activities. Examples include a farmer switching to growing a different crop variety better suited to warmer or drier conditions; a company relocating key business centers away from coastal areas vulnerable to sea-level rise and hurricanes, and a community

altering its zoning and building codes to place fewer structures in harm's way and making buildings less vulnerable to damage from floods, fires, and other extreme events. Some adaptation options that are currently being pursued in various regions and sectors to deal with climate change and/or other environmental issues are identified in this report. However, it is clear that there are limits to how much adaptation can achieve.

Humans have adapted to changing climatic conditions in the past, but in the future, adaptations will be particularly challenging because society won't be adapting to a new steady state but rather to a rapidly moving target. Climate will be continually changing, moving at a relatively rapid rate, outside the range to which society has adapted in the past. The precise amounts and timing of these changes will not be known with certainty.

In an increasingly interdependent world, U.S. vulnerability to climate change is linked to the fates of other nations. For example, conflicts or mass migrations of people resulting from food scarcity and other resource limits, health impacts, or environmental stresses in other parts of the world could threaten U.S. national security. It is thus difficult to fully evaluate the impacts of climate change on the United States without considering the consequences of climate change elsewhere. However, such analysis is beyond the scope of this report.

Finally, this report identifies a number of areas in which inadequate information or understanding hampers our ability to estimate future climate change and its impacts. For example, our knowledge of changes in tornadoes, hail, and ice storms is quite limited, making it difficult to know if and how such events have changed as climate has warmed, and how they might change in the future. Research on ecological responses to climate change is also limited, as is our understanding of social responses. The section titled *An Agenda for Climate Impacts Science* at the end of this report offers some thoughts on the most important ways to improve our knowledge. Results from such efforts would inform future assessments that continue building our understanding of humanity's impacts on climate, and climate's impacts on us.



Key Findings

1. Global warming is unequivocal and primarily human-induced.

Global temperature has increased over the past 50 years. This observed increase is due primarily to human-induced emissions of heat-trapping gases. (p. 13)

2. Climate changes are underway in the United States and are projected to grow.

Climate-related changes are already observed in the United States and its coastal waters. These include increases in heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons, lengthening ice-free seasons in the ocean and on lakes and rivers, earlier snowmelt, and alterations in river flows. These changes are projected to grow. (p. 27)

3. Widespread climate-related impacts are occurring now and are expected to increase.

Climate changes are already affecting water, energy, transportation, agriculture, ecosystems, and health. These impacts are different from region to region and will grow under projected climate change. (p. 41-106, 107-152)

4. Climate change will stress water resources.

Water is an issue in every region, but the nature of the potential impacts varies. Drought, related to reduced precipitation, increased evaporation, and increased water loss from plants, is an important issue in many regions, especially in the West. Floods and water quality problems are likely to be amplified by climate change in most regions. Declines in mountain snowpack are important in the West and Alaska where snowpack provides vital natural water storage. (p. 41, 129, 135, 139)

5. Crop and livestock production will be increasingly challenged.

Many crops show positive responses to elevated carbon dioxide and low levels of warming, but higher levels of warming often negatively affect growth and yields. Increased pests, water stress, diseases, and weather extremes will pose adaptation challenges for crop and livestock production. (p. 71)

6. Coastal areas are at increasing risk from sea-level rise and storm surge.

Sea-level rise and storm surge place many U.S. coastal areas at increasing risk of erosion and flooding, especially along the Atlantic and Gulf Coasts, Pacific Islands, and parts of Alaska. Energy and transportation infrastructure and other property in coastal areas are very likely to be adversely affected. (p. 131, 139, 145, 149)

7. Risks to human health will increase.

Harmful health impacts of climate change are related to increasing heat stress, waterborne diseases, poor air quality, extreme weather events, and diseases transmitted by insects and rodents. Reduced cold stress provides some benefits. Robust public health infrastructure can reduce the potential for negative impacts. (p. 89)

8. Climate change will interact with many social and environmental stresses.

Climate change will combine with pollution, population growth, overuse of resources, urbanization, and other social, economic, and environmental stresses to create larger impacts than from any of these factors alone. (p. 99)

9. Thresholds will be crossed, leading to large changes in climate and ecosystems.

There are a variety of thresholds in the climate system and ecosystems. These thresholds determine, for example, the presence of sea ice and permafrost, and the survival of species, from fish to insect pests, with implications for society. With further climate change, the crossing of additional thresholds is expected. (p. 76, 82, 115, 137, 142)

10. Future climate change and its impacts depend on choices made today.

The amount and rate of future climate change depend primarily on current and future human-caused emissions of heat-trapping gases and airborne particles. Responses involve reducing emissions to limit future warming, and adapting to the changes that are unavoidable. (p. 25, 29)



Southwest

The Southwest region stretches from the southern Rocky Mountains to the Pacific Coast. Elevations range from the lowest in the country to among the highest, with climates ranging from the driest to some of the wettest. Past climate records based on changes in Colorado River flows indicate that drought is a frequent feature of the Southwest, with some of the longest documented “megadroughts” on Earth. Since the 1940s, the region has experienced its most rapid population and urban growth. During this time, there were both unusually wet periods (including much of 1980s and 1990s) and dry periods (including much of 1950s and 1960s).⁴⁴ The prospect of future droughts becoming more severe as a result of global warming is a significant concern, especially because the Southwest continues to lead the nation in population growth.

Human-induced climate change appears to be well underway in the Southwest. Recent warming is among the most rapid in the nation, significantly more than the global average in some areas. This is driving declines in spring snowpack and Colorado

River flow.^{45,46,46} Projections suggest continued strong warming, with much larger increases under higher emissions scenarios⁴⁷ compared to lower emissions scenarios. Projected summertime temperature increases are greater than the annual average increases in some parts of the region, and are likely to be exacerbated locally by expanding urban heat island effects.⁴⁸ Further water cycle changes are projected, which, combined with increasing temperatures, signal a serious water supply challenge in the decades and centuries ahead.^{44,49}

Water supplies are projected to become increasingly scarce, calling for trade-offs among competing uses, and potentially leading to conflict.

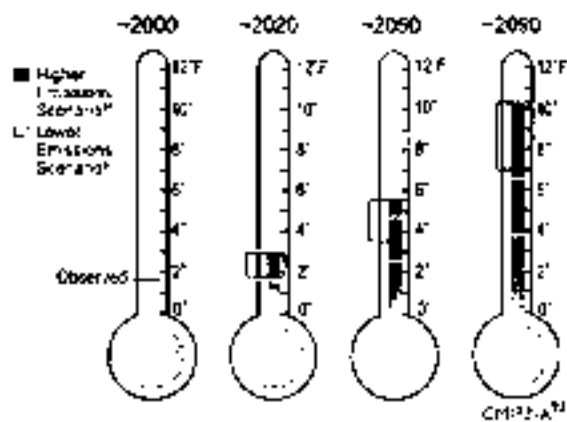
Water is, quite literally, the lifeblood of the Southwest. The largest use of water in the region is associated with agriculture, including some of the nation’s most important crop-producing areas in California. Water is also an important source of hydroelectric power, and water is required for the large population growth in the region, particularly that of major cities such as Phoenix and Las Vegas. Water also plays a critical role in supporting healthy ecosystems across the region, both on land and in rivers and lakes.

Water supplies in some areas of the Southwest are already becoming limited, and this trend toward scarcity is likely to be a harbinger of future water shortages.^{44,45} Groundwater pumping is lowering water tables, while rising temperatures reduce river flows in vital rivers including the Colorado.⁴⁴ Limitations imposed on water supply by projected temperature increases are likely to be made worse by substantial reductions in rain and snowfall in the spring months, when precipitation is most needed to fill reservoirs to meet summer demand.⁴⁹

A warmer and drier future means extra care will be needed in planning the allocation of water for



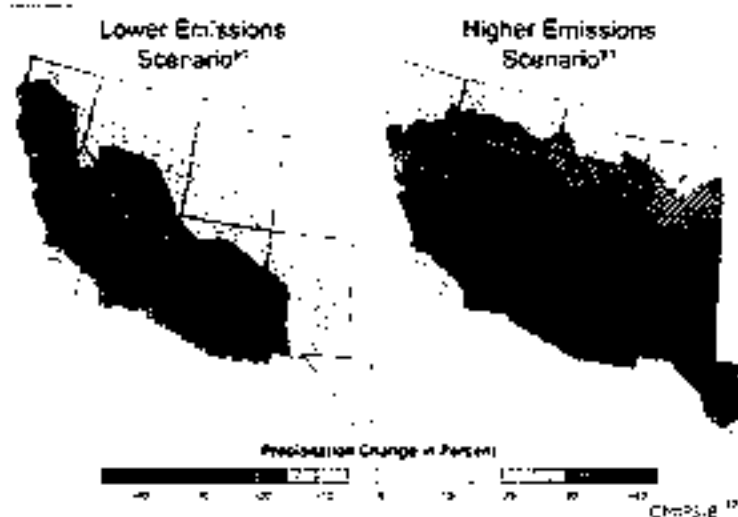
Observed and Projected Temperature Rise



The average temperature in the Southwest has already increased roughly 1.5°F compared to a 1960-1979 baseline period. By the end of the century, average annual temperature is projected to rise approximately 4°F to 10°F above the historical baseline, averaged over the Southwest region. The brackets on the thermometers represent the likely range of model projections, though lower or higher outcomes are possible.

the coming decades. The Colorado Compact, negotiated in the 1920s, allocated the Colorado River's water among the seven basin states. It was based, however, on unrealistic assumptions about how much water was available because the observations of runoff during the early 1900s turned out to be part of the greatest and

Projected Change in Spring Precipitation, 2080-2099



Percentage change in March-April-May precipitation for 2080-2099 compared to 1961-1979 for a lower emissions scenario¹¹ (left) and a higher emissions scenario¹² (right). Confidence in the projected changes is highest in the hatched areas.

longest high-flow period of the last five centuries.⁴² Today, even in normal decades, the Colorado River does not have enough water to meet the agreed-upon allocations. During droughts and under projected future conditions, the situation looks even bleaker.

During droughts, water designated for agriculture could provide a temporary back-up supply for urban water needs. Similarly, non-renewable groundwater could be tapped during especially dry periods. Both of these options, however, come at the cost of either current or future agricultural production.

Water is already a subject of contention in the Southwest, and climate change – coupled with rapid population growth – promises to increase the likelihood of water-related

Future of Drought in the Southwest

Droughts are a long-standing feature of the Southwest's climate. The droughts of the last 110 years pale in comparison to some of the decades-long "megadroughts" that the region has experienced over the last 2000 years.⁴³ During the closing decades of the 1500s, for example, major droughts gripped parts of the Southwest.⁴⁴ These droughts sharply reduced the flow of the Colorado River^{45,46} and the all-important Sierra Nevada headwaters for California,⁴⁵ and dried out the region as a whole. As of 2009, much of the Southwest remains in a drought that began around 1999. This event is the most severe western drought of the last 110 years, and is being exacerbated by record warming.⁴³

Over this century, projections point to an increasing probability of drought for the region.^{30,45} Many aspects of these projections, including a northward shift in winter and spring storm tracks, are consistent with observed trends over recent decades.^{34,45,47} Thus, the most likely future for the Southwest is a substantially drier one (although there is presently no consensus on how the region's summer monsoon [rainy season] might change in the future). Combined with the historical record of



Some droughts in the past have been more severe and longer-lasting than any in the last century. Colorado River flow has been reconstructed back over 1200 years based primarily on tree-ring data. These data reveal that some droughts in the past have been more severe and longer-lasting than any experienced in the last 100 years. The red line indicates actual measurements of river flow during the last 200 years. Models indicate that, in the future, droughts will continue to occur, but will become hotter, and thus more severe, over time.³⁰

severe droughts and the current uncertainty regarding the exact causes and drivers of these past events, the Southwest must be prepared for droughts that could potentially result from multiple causes. The combined effects of natural climate variability and human-induced climate change could turn out to be a devastating "one-two punch" for the region.

conflict. Projected temperature increases, combined with river-flow reductions, will increase the risk of water conflicts between sectors, states, and even nations. In recent years, negotiations regarding existing water supplies have taken place among the seven states sharing the Colorado River and the two states (New Mexico and Texas) sharing the Rio Grande. Mexico and the United States already disagree on meeting their treaty allocations of Rio Grande and Colorado River water.

In addition, many water settlements between the U.S. Government and Native American tribes have yet to be fully worked out. The Southwest is home to dozens of Native communities whose status as sovereign nations means they hold rights to the water for use on their land. However, the amount of water actually available to each nation is determined through negotiations and litigation. Increasing water demand in the Southwest is driving current negotiations and litigation of tribal water rights. While several nations have legally settled their water rights, many other tribal negotiations are either currently underway or pending. Competing demands from treaty rights, rapid development, and changes in agriculture in the region, exacerbated by years of drought and climate change, have the potential to spark significant conflict over an already over-allocated and dwindling resource.

Increasing temperature, drought, wildfire, and invasive species will accelerate transformation of the landscape.

Climate change already appears to be influencing both natural and managed ecosystems of the Southwest.^{448,449} Future landscape impacts are likely to be substantial, threatening biodiversity, protected areas, and ranching and agricultural lands. These changes are often driven by multiple factors, including changes in temperature and drought patterns, wildfire, invasive species, and pests.

Conditions observed in recent years can serve as indicators for future change. For example, temperature increases have made the current drought in the region more severe than the natural droughts of the last several centuries. As a result, about 4,600

square miles of piñon-juniper woodland in the Four Corners region of the Southwest have experienced substantial die-off of piñon pine trees.⁴⁵⁰ Record wildfires are also being driven by rising temperatures and related reductions in spring snowpack and soil moisture.⁴⁵¹

How climate change will affect fire in the Southwest varies according to location. In general, total area burned is projected to increase.⁴⁵² How this plays out at individual locations, however, depends on regional changes in temperature and precipitation, as well as on whether fire in the area is currently limited by fuel availability or by rainfall.⁴⁵³ For example, fires in wetter, forested areas are expected to increase in frequency, while areas where fire is limited by the availability of fine fuels experience decreases.⁴⁵⁴ Climate changes could also create subtle shifts in fire behavior, allowing more “runaway fires” – fires that are thought to have been brought under control, but then rekindle.⁴⁵⁵ The magnitude of fire damages, in terms of economic impacts as well as direct endangerment, also increases as urban development increasingly impinges on forested areas.^{456,457}

Climate-fire dynamics will also be affected by changes in the distribution of ecosystems across the Southwest. Increasing temperatures and shifting precipitation patterns will drive declines in high-elevation ecosystems such as alpine forests and tundra.^{458,459} Under higher emissions scenarios,⁶ high-elevation forests in California, for example, are projected to decline by 60 to 90 percent before the end of the century.^{460,461} At the same time, grasslands are projected to expand, another factor likely to increase fire risk.

As temperatures rise, some iconic landscapes of the Southwest will be greatly altered as species shift their ranges northward and upward to cooler climates, and fires attack unaccustomed ecosystems which lack natural defenses. The Sonoran Desert, for example, famous for the saguaro cactus, would look very different if more woody species spread northward from Mexico into areas currently dominated by succulents (such as cacti) or native grasses.⁴⁶² The desert is already being invaded by red brome and buffle grasses that do well in high temperatures and are native to Africa and the



Change in Population from 1970 to 2008



The map above of percentage changes in county population between 1970 and 2008 shows that the Southwest has experienced very rapid growth in recent decades (indicated in orange, red, and maroon).

Mediterranean. Not only do these noxious weeds out-compete some native species in the Sonoran Desert, they also fuel hot, cactus-killing fires. With these invasive plant species and climate change, the Saguaro and Joshua Tree national parks could end up with far fewer of their namesake plants.⁴⁴ In California, two-thirds of the more than 5,500 native plant species are projected to experience range reductions up to 80 percent before the end of this century under projected warming.⁴⁵ In their search for optimal conditions, some species will move uphill, others northward, breaking up present-day

ecosystems; those species moving southward to higher elevations might cut off future migration options as temperatures continue to increase.

The potential for successful plant and animal adaptation to coming change is further hampered by existing regional threats such as human-caused fragmentation of the landscape, invasive species, river-flow reductions, and pollution. Given the mountainous nature of the Southwest and the associated impediments to species shifting their ranges, climate change likely places other species at risk. Some areas have already been identified as possible refuges where species at risk could continue to live if these areas were preserved for this purpose.⁴⁶ Other rapidly changing landscapes will require major adjustments, not only from plant and animal species, but also by the region's ranchers, foresters, and other inhabitants.

Increased frequency and altered timing of flooding will increase risks to people, ecosystems, and infrastructure.

Paradoxically, a warmer atmosphere and an intensified water cycle are likely to mean not only a greater likelihood of drought for the Southwest, but also an increased risk of flooding. Winter precipitation in Arizona, for example, is already

A Biodiversity Hotspot

The Southwest is home to two of the world's 34 designated "biodiversity hotspots." These at-risk regions have two special qualities: they hold unusually large numbers of plant and animal species that are endemic (found nowhere else), and they have already lost over 70 percent of their native vegetation.^{47,48} About half the world's species of plants and land animals occur only in these 34 locations, though they cover just 2.3 percent of the Earth's land surface.

One of these biodiversity hotspots is the Madrean Pine-Oak Woodlands. Once covering 178 square miles, only isolated patches remain in the United States, mainly on mountaintops in southern Arizona, New Mexico, and West Texas. The greatest diversity of pine species in the world grows in this area: 44 of the 110 varieties,⁴⁹ as well as more than 150 species of oak.⁵⁰ Some 5,300 to 6,700 flowering plant species inhabit the ecosystem, and over 500 bird species, 23 of which are endemic. More hummingbirds are found here than anywhere else in the United States. There are 384 species of reptiles, 37 of which are endemic, and 328 species of mammals, six of which are endemic. There are 84 fish species, 18 of which are endemic. Some 200 species of butterfly thrive here, of which 45 are endemic, including the Monarch that migrates 2,500 miles north to Canada each year.⁵¹ Ecotourism has become the economic driver in many parts of this region, but logging, land clearing for agriculture, urban development, and now climate change threaten the region's viability.

becoming more variable, with a trend toward both more frequent extremely dry and extremely wet winters.⁴² Some water systems rely on smaller reservoirs being filled up each year. More frequent dry winters suggest an increased risk of these systems running short of water. However, a greater potential for flooding also means reservoirs cannot be filled to capacity as safely in years where that is possible. Flooding also causes reservoirs to fill with sediment at a faster rate, thus reducing their water-storage capacities.

On the global and national scales, precipitation patterns are already observed to be shifting, with more rain falling in heavy downpours that can lead to flooding.⁴³ Rapid landscape transformation due to vegetation die off and wildfire as well as loss of wetlands along rivers is also likely to reduce flood buffering capacity. Moreover, increased flood risk in the Southwest is likely to result from a combination of decreased snow cover on the lower slopes of high mountains, and an increased fraction of winter precipitation falling as rain and therefore running off more rapidly.⁴⁴ The increase in rain on snow events will also result in rapid runoff and flooding.⁴⁵

The most obvious impact of more frequent flooding is a greater risk to human beings and their infrastructure. This applies to locations along major rivers, but also to much broader and highly vulnerable areas such as the Sacramento–San Joaquin River Delta system. Stretching from the San Francisco Bay nearly to the state capital of Sacramento, the Sacramento–San Joaquin River Delta and Suisun Marsh make up the largest estuary on the West Coast of North America. With its rich soils and rapid subsidence rates – in some locations as high as 2 or more feet per decade – the entire Delta region is now below sea level, protected by more than a thousand miles of levees and dams.⁴⁶ Projected changes in the timing and amount of river flow, particularly in winter and spring, is estimated to more than double the risk of Delta flooding events by mid-century, and result in an eight-fold increase before the end of the century.⁴⁷ Taking into account the additional risk of a major seismic event and increases in sea level due to climate change over this century, the California Bay Delta Authority has concluded that the Delta and Suisun Marsh are

not sustainable under current practices; efforts are underway to identify and implement adaptation strategies aimed at reducing these risks.⁴⁸

Unique tourism and recreation opportunities are likely to suffer.

Tourism and recreation are important aspects of the region's economy. Increasing temperatures will affect important winter activities such as downhill and cross-country skiing, snowshoeing, and snowmobiling, which require snow on the ground. Projections indicate later snow and less snow coverage in ski resort areas, particularly those at lower elevations and in the southern part of the region.⁴⁹ Decreases from 40 to almost 90 percent are likely in end-of-season snowpack under a higher emissions scenario⁵⁰ in counties with major ski resorts from New Mexico to California.⁵¹ In addition to shorter seasons, earlier wet snow avalanches – more than six weeks earlier by the end of this century under a higher emissions scenario⁵² – could force ski areas to shut down affected runs before the season would otherwise end.⁵³ Resorts require a certain number of days just to break even; cutting the season short by even a few weeks, particularly if those occur during the lucrative holiday season, could easily render a resort unprofitable.

Even in non-winter months, ecosystem degradation will affect the quality of the experience for hikers, bikers, birders, and others who enjoy the Southwest's natural beauty. Water sports that depend on the flows of rivers and sufficient water in lakes and reservoirs are already being affected, and much larger changes are expected.



Cities and agriculture face increasing risks from a changing climate.

Resource use in the Southwest is involved in a constant three-way tug-of-war among preserving natural ecosystems, supplying the needs of rapidly expanding urban areas, and protecting the lucrative agricultural sector, which, particularly in California, is largely based on highly temperature- and water-sensitive specialty crops. Urban areas are also sensitive to temperature-related impacts on air

quality, electricity demand, and the health of their inhabitants.

The magnitude of projected temperature increases for the Southwest, particularly when combined with urban heat island effects for major cities such as Phoenix, Albuquerque, Las Vegas, and many California cities, represent significant stresses to health, electricity, and water supply in a region that already experiences very high summer temperatures.^{45,46,47}

If present-day levels of ozone-producing emissions are maintained, rising temperatures also imply declining air quality in urban areas such as those in California which already experience some of the worst air quality in the nation (see *Society* sector).⁴⁸ Continued rapid population growth is expected to exacerbate these concerns.

With more intense, longer-lasting heat wave events projected to occur over this century, demands for air conditioning are expected to deplete electricity supplies, increasing risks of brownouts and blackouts.⁴⁹ Electricity supplies will also be affected by changes in the timing of river flows and where hydroelectric systems have limited storage capacity and reservoirs (see *Energy* sector).^{45,49}

Much of the region's agriculture will experience detrimental impacts in a warmer future,

particularly specialty crops in California such as apricots, almonds, artichokes, figs, kiwis, olives, and walnuts.^{45,47} These and other specialty crops require a minimum number of hours at a chilling temperature threshold in the winter to become dormant and set fruit for the following year.⁴⁷ Accumulated winter chilling hours have already decreased across central California and its coastal valleys. This trend is projected to continue to the point where chilling thresholds for many key crops would no longer be met. A steady reduction in winter chilling could have serious economic impacts on fruit and nut production in the region. California's losses due to future climate change are estimated between zero and 40 percent for wine and table grapes, almonds, oranges, walnuts, and avocados, varying significantly by location.⁴⁵

Adaptation strategies for agriculture in California include more efficient irrigation and shifts in cropping patterns, which have the potential to help compensate for climate-driven increases in water demand for agriculture due to rising temperatures.⁴⁴ The ability to use groundwater and/or water designated for agriculture as backup supplies for urban uses in times of severe drought is expected to become more important in the future as climate change dries out the Southwest; however, these supplies are at risk of being depleted as urban populations swell (see *Water* sector).

Adaptation: Strategies for Fire

Living with present-day levels of fire risk, along with projected increases in risk, involves actions by residents along the urban-forest interface as well as fire and land management officials. Some basic strategies for reducing damage to structures due to fires are being encouraged by groups like National Firewise Communities, an interagency program that encourages wildfire preparedness measures such as creating defensible space around residential structures by thinning trees and brush, choosing fire-resistant plants, selecting ignition-resistant building materials and design features, positioning structures away from slopes, and working with firefighters to develop emergency plans.

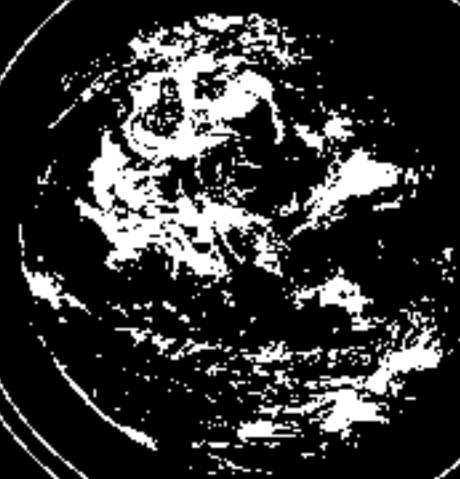
Additional strategies for responding to the increased risk of fire as climate continues to change could include adding firefighting resources⁴⁶ and improving evacuation procedures and communications infrastructure. Also important would be regularly updated insights into what the latest climate science implies for changes in types, locations, timing, and potential severity of fire risks over seasons to decades and beyond; implications for related political, legal, economic, and social institutions; and improving predictions for regeneration of burnt-over areas and the implications for subsequent fire risks. Reconsideration of policies that encourage growth of residential developments in or near forests is another potential avenue for adaptive strategies.⁵⁰



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A CALL FOR

Consensus Principles and Recommendations
from the U.S. Climate Action Partnership
A Business and NGO Partnership





USCAP

United States
Climate Action
Partnership

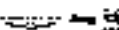


Boston
Scientific



CATERPILLAR

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Exelon



Johnson & Johnson

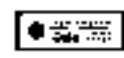
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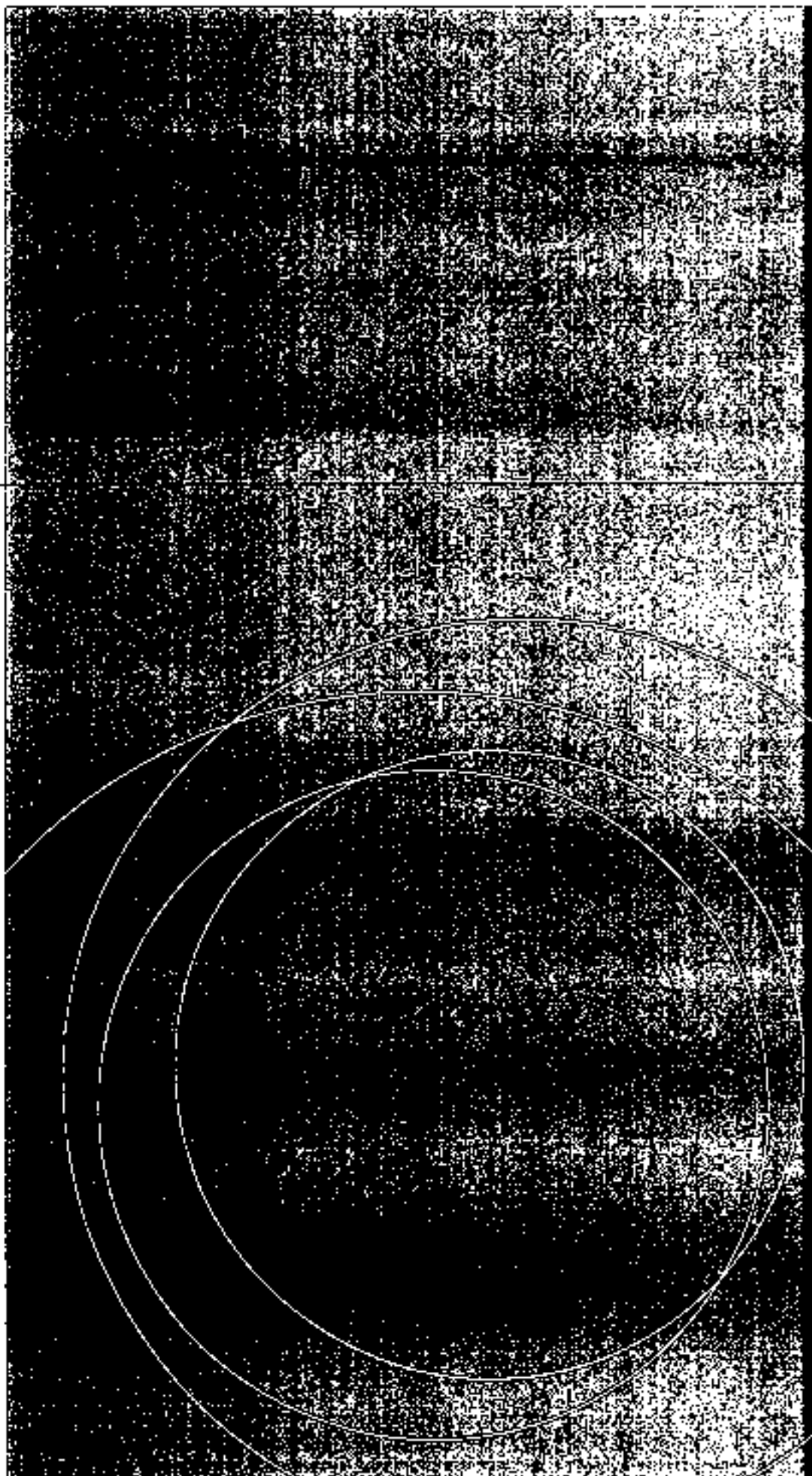
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A CALL FOR ACTION

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U.S. Climate Action
Partnership Members

An aerial photograph of a coastal area. In the foreground, a multi-lane highway with a dashed center line curves along the right side. To the left of the highway is a body of water, possibly a bay or inlet, with a bridge crossing it. The background shows a coastline with green hills and buildings under a clear sky.

A CALL FOR ACTION

We Know Enough to Act on Climate Change

In June 2005, the U.S. National Academy of Sciences joined with the scientific academies of ten other countries in stating that “the scientific understanding of climate change is now sufficiently clear to justify nations taking prompt actions.”

Each year we delay action to control emissions increases the risk of unavoidable consequences that could necessitate even steeper reductions in the future, at potentially greater economic cost and social disruption. Action sooner rather than later preserves valuable response options, narrows the uncertainties associated with changes to the climate, and should lower the costs of mitigation and adaptation.

For these reasons, we, the members of the U.S. Climate Action Partnership (USCAP) have joined together to recommend the prompt enactment of national legislation in the United States to slow, stop and reverse the growth of greenhouse gas (GHG) emissions over the shortest period of time reasonably achievable.

Please see the Appendix on page 12 for a list of USCAP members and please visit www.us-cap.org for more information.

The Challenge is Significant, But the United States Can Grow and Prosper in a Greenhouse Gas Constrained World

The scale of the undertaking to address climate change is enormous, and should not be underestimated. For this issue to be successfully addressed—and failure is not an option—the way we produce and use energy must fundamentally change, both nationally and globally.

In our view, the climate change challenge, like other challenges our country has confronted in the past, will create more economic opportunities than risks for the U.S. economy. Indeed, addressing climate change will require innovation and products that drive increased energy efficiency, creating new markets. This innovation will lead directly to increased U.S. competitiveness, as well as reduced reliance on energy from foreign sources. Our country will thus benefit through increased energy security and an improved balance of trade. We believe that a national mandatory policy on climate change will provide the basis for the United States to assert world leadership in environmental and energy technology innovation, a national characteristic for which the United States has no rival. Such leadership will assure U.S. competitiveness in this century and beyond.

In our view, the climate change challenge will create more economic opportunities than risks for the U.S. economy.

We Need a Mandatory, Flexible Climate Program

We believe a U.S. policy framework must include the following:

- Mandatory approaches to reduce greenhouse gas emissions from the major emitting sectors including emissions from large stationary sources, transportation, and energy use in commercial and residential buildings that could be phased in over time, with attention to near-, mid- and long-term time horizons.
- Flexible approaches to establish a price signal for carbon that may vary by economic sector and could include, depending on the sector, market-based incentives, performance standards, cap-and-trade, tax reform, incentives for technology research, development, and deployment, or other appropriate policy tools; and
- Approaches that create incentives and encourage actions by other countries, including large emitting economies in the developing world, to implement GHG emission reduction strategies.



OUR DESIGN PRINCIPLES

We believe U.S. Climate legislation must include the following design principles.

Account for the Global Dimensions of Climate Change

The effects of climate change are global, as are the sources of GHG emissions. Success will require commitments by all of the major emitting countries. Toward this end, the U.S. government should become more involved in developing the post-2012 international arrangements for addressing climate change that are now being discussed. While care should be taken that policies do not merely push emissions from U.S. facilities to overseas plants, ultimately there must be an international program for addressing climate change and its impacts. U.S. action to implement mandatory measures and incentives for reducing emissions should not be contingent on simultaneous action by other countries. Rather, we believe that U.S. leadership is essential for establishing an equitable and effective international policy framework for robust action by all major emitting countries.

Recognize the Importance of Technology

There are a number of technologies that are currently available that emit little or no GHGs, such as wind, solar, and nuclear power, hybrid vehicles, and numerous energy efficiency technologies. The cost-effective deployment of existing technologies to improve energy efficiency and reduce GHG emissions should be a priority, as it will yield emission reductions in the near-term while new technologies are developed. The most efficient and powerful way to stimulate private investment in research, development, and deployment is to adopt policies establishing a market value for GHG emissions over the long-term. Where near-term price signals are insufficient to deploy cleaner existing technologies, additional incentives or other measures must be considered, especially where carbon emissions could be significantly reduced and the "lock-in" of future carbon emissions avoided. Rapid advancement and deployment of new, breakthrough technologies are also core elements of any climate change solution. Thus, an effective climate change program must include policies to promote significant research, development and deployment of hyper-efficient end use technologies; low-or-zero-GHG emitting technologies; and cost-effective carbon capture and storage, which will be particularly important in the deployment of advanced coal technologies.

Be Environmentally Effective

Climate stabilization requires immediate action and sustained effort over several decades. Mandatory requirements and incentives must be stringent enough to achieve necessary emissions reductions within timeframes that prevent an unacceptable level of GHG concentrations and climate change. We must start a program in the near term that captures short range reduction opportunities, puts us on the path to stabilizing concentrations, and preserves our options to avoid an unacceptable level of climate change in the future.

Climate stabilization requires immediate action and sustained effort over several decades.

Create Economic Opportunity and Advantage

Addressing climate change must be achieved in a highly cost-effective manner that allows for economic growth in both the developed world and emerging economies. A climate protection program must use the power of the market through reliance on institutional and regulatory structures that establish clear targets and timeframes. Requirements for reducing emissions may vary between sectors and should be designed to promote sustained economic growth and prompt, efficient action in the shortest time reasonably achievable, compatible with the goal of preventing dangerous human interference with the climate.

Be Fair

Some economic sectors, geographic regions, and income groups may be disproportionately impacted by both climate change impacts and mandatory GHG reductions. Any climate protection program needs to take account of these impacts and provide appropriate assistance to those disadvantaged or disproportionately impacted by such program.

Encourage Early Action

Prior to the effective date of mandatory emission limits, every reasonable effort should be made to reduce emissions. Those companies that take early action should be given appropriate credit or otherwise be rewarded for their early reductions in GHG emissions.



OUR RECOMMENDATIONS

Congress Needs to Enact Legislation as Quickly as Possible

We offer the following interconnected set of recommendations for the general structure and key elements of climate protection legislation that we urge Congress to enact as quickly as possible. The legislation should require actions to be implemented on a fast track while a cap and trade program is put in place, including the establishment of a GHG inventory and registry, credit for early action, aggressive technology research and development, and policies to discourage new investments in high-emitting facilities and accelerate deployment of zero and low-emitting technologies and energy efficiency. We recommend these fast track actions begin within one year of enactment.

The Environmental Goal

U.S. legislation should be designed to achieve the goal of limiting global atmospheric GHG concentrations to a level that minimizes large-scale adverse climate change impacts to human populations and the natural environment, which will require global GHG concentrations to be stabilized over the long term at a carbon dioxide equivalent level between 450–550 parts per million.

Take a Stepwise, Cost-Effective Approach

While achieving our environmental goal will require a fundamental transformation of the energy system over the long term, we cannot predict with accuracy all technological developments between now and 2100. For these reasons, legislation should focus on what we know can be cost-effectively achieved over the next twenty to forty years while putting us on a trajectory for deeper emission reductions by mid-century.

Cap and Trade is Essential

Our environmental goal and economic objectives can best be accomplished through an economy-wide, market-driven approach that includes a cap and trade program that places specified limits on GHG emissions. This approach will ensure emission reduction targets will be met while simultaneously generating a price signal resulting in market incentives that stimulate investment and innovation in the technologies that will be necessary to achieve our environmental goal. The U.S. climate protection program should create a domestic market that will establish a uniform price for GHG emissions for all sectors and should promote the creation of a global market.

We are committed to a pathway that will slow, stop and reverse the growth of U.S. emissions.

Establish Short and Mid-Term GHG Emission Targets

To begin the process of reducing U.S. emissions, we recommend Congress establish a mandatory emission reduction pathway with specific targets that are:

- between 100–105% of today's levels within five years of rapid enactment
- between 90–100% of today's levels within ten years of rapid enactment
- between 70–90% of today's levels within fifteen years of rapid enactment

The short and mid-term targets selected by Congress should be aimed at making it clear to the millions of actors in our economy and to other nations that we are committed to a pathway that will slow, stop and reverse the growth of U.S. emissions. Furthermore, Congress should specify an emission target zone aimed at reducing emissions by 60% to 80% from current levels by 2050.

Complementary Policies and Measures Will be Necessary

Climate protection policies must be complemented with U.S. energy policies that result in diverse and adequate supplies of low GHG energy. In addition, as described below, an aggressive technology research, development, and demonstration program, along with policies aimed at deploying low- and zero-emission technologies will be necessary to achieve our policy goals. In sectors that are insensitive to price signals and that face market barriers to the introduction or utilization of low or zero-emission technology, we recommend appropriate sector-specific policies.

Scope of Coverage and Point of Regulation of the Cap and Trade Program

We recommend the cap and trade program should cover as much of the economy's GHG emissions as is politically and administratively possible. We believe there are potentially effective approaches to achieving these objectives including the following:

- An "upstream" program that requires fossil fuel producers (or shippers in the case of natural gas) to be covered by allowances that equal the emissions released when the fuel is combusted, thereby adding the cost of the emission reduction allowance to the price of the fuel; OR
- A "hybrid" program that includes a downstream cap applied to GHG emissions from large stationary sources (e.g., covering 80% of the emissions from the fewest possible number of sources) combined with an upstream cap or another policy tool applied to the carbon content of fossil fuels used by remaining sources.

Emission Offsets

Legislation should permit entities subject to the cap to meet part of their obligations through the purchase of verified emission offsets from a range of domestic sinks, domestic sources of emissions that are not subject to the cap, and projects outside the US. The offset must be environmentally additional, verifiable, permanent, and enforceable.

Emission Allowance Allocations

An emission allowance allocation system should seek to mitigate economic transition costs to entities and regions of the country that will be relatively more adversely affected by GHG emission limits or have already made investments in higher cost, low-GHG technologies, while simultaneously encouraging the transition from older, higher-emitting technologies to newer, lower-emitting technologies. A significant portion of allowances should be initially distributed free to capped entities and to economic sectors particularly disadvantaged by the secondary price effects of a cap including the possibility of handing transition assistance to adversely affected workers and communities. Free allocations to the private sector should be phased out over a reasonable period of time.

Cost Control Measures

Cost control measures are policies designed to provide capped entities with greater confidence that their cost will be limited and flexibility to manage emissions reduction compliance costs. We believe the most powerful cost control measure is a robust cap and trade program, since markets do the best job of controlling costs over time. If used, cost control measures must be designed to enable a long-term price signal that is stable and high enough to drive investment in low- and zero-emitting technologies, including carbon capture and storage. Any additional cost-control option considered by Congress must ensure the integrity of the emissions cap over a multi-year

period and preserve the market's effectiveness in driving reductions, investment, and innovation. As policy makers weigh additional cost control options, it is important for them to consider who and what portions of the economy are impacted, the time duration of the impact and remedy, international competitiveness, the implications for international emissions trading, and how the measure impacts the price signal necessary to stimulate investment and technological innovation. Some possible additional cost control options include but are not limited to a safety valve, borrowing, strategic allowance reserve, preferential allocations, dedicated funding, technology incentives and transition assistance.

Inventory and Registry

A national emissions baseline must be established. Legislation should establish a registry by no later than the end of 2008. The final regulations establishing a national registry and inventory of GHG emissions should ensure consistency in the definition, counting, and reporting of GHG emissions from all regulated entities (i.e., those that are subjected to the cap) and from all other emission sources on a voluntary basis. The U.S. inventory should include an estimate of all GHG emissions, not just those in the registry.

Credit for Early Action

It will take time to get a cap and trade program up and running. We need to reward those firms that have acted to reduce GHG emissions and encourage others to do so while the program is being established. Legislation should require regulations to be promulgated by no later than the end of 2008 establishing an early action program that grants a credit for reductions made starting from a specified date, such as 1995, until such time as the mandatory program becomes effective. Claimants would be required to demonstrate their eligibility for the credit based on accurate data.

We need to reward those firms that have acted to reduce GHG emissions and encourage others to do so while the program is being established.

Technology Policies and Measures

A federal technology research, development and demonstration (RD&D) and deployment program is a necessary complement to the GHG reduction policies that will drive demand for low-carbon technology. The program should be designed with the following key characteristics:

- Joint public/private sector cost-sharing and oversight;
- Establishment of performance criteria and a technology roadmap to guide RD&D and deployment program investment decisions;
- Stable, long-term financing (e.g., a dedicated federal revenue stream or other means not reliant upon annual congressional appropriations);
- Establishment of a public/private institution to govern the administration of the RD&D and deployment program fund; and
- A mix of deployment policies to create incentives to use low-GHG technologies and address regulatory or financial barriers. Such policies could include loan guarantees, investment tax credits, and procurement standards.

Sector-Specific Policies and Measures

Policies and measures are needed to complement an economically sound cap and trade system to create additional incentives to invest in low-GHG approaches in key sectors. The need and scope of sector-specific policies and measures will depend on the stringency of targets, scope of coverage, and point of regulation in the cap and trade program. Some of the sector-specific policies and measures are intended to be transitional in nature and should be phased out over time. The following are suggestions for sector-specific policies and measures.

NEW COAL-BASED ENERGY FACILITIES AND OTHER STATIONARY SOURCES¹

Coal supplies over fifty percent of our current electricity generation and will play a continuing role in our energy future. Policies are needed to speed transition to low- and zero emission stationary sources that can most effectively capture CO₂ emissions for geologic sequestration. We do not take a position as a group on any specific project, even though as individual organizations many USCAP Members do have such positions.

CARBON CAPTURE AND STORAGE

Congress should require the EPA to promulgate regulations promptly to permit long-term geologic sequestration of carbon dioxide from stationary sources. Congress should fund at least three sequestration demonstration projects in depleted and abandoned oil and gas fields and saline aquifers with CO₂ injection, each at levels equivalent to emissions produced by a large coal-based power plant.

¹ The language contained in this section has been revised from the original version of this report to clarify the intent of the USCAP.

TRANSPORTATION SOURCES

Climate protection legislation must achieve substantial GHG emission reductions from all major emitting sectors of the economy, including the transportation sector. We recommend Congress enact policies to reduce GHG emissions in the transportation sector, including consideration of policies to:

- Promote lower carbon transportation fuels;
 - Cost-effectively decrease allowable GHG emissions of automobile manufacturers' fleets and promote new low-emissions vehicles, for example with GHG or fuel economy performance standards.
- Efficiently decrease vehicle miles traveled and enhance mass transit and other less carbon-intensive transportation alternatives.
- Promote better growth planning.
- Educate consumers; and
- Address emissions from air, rail, and marine transport.

BUILDINGS AND ENERGY EFFICIENCY

Policies are needed to realize the full potential of energy efficiency as a high priority energy resource and a cost-effective means of reducing GHG emissions. To achieve this objective, climate legislation should establish federal and state policies that align financial and regulatory incentives with utilities' business interests to aggressively pursue energy efficiency programs and promote policies that "decouple" utility sales and revenues in conjunction with requirements for utilities to pursue all cost-effective energy efficiency savings. Stronger energy efficiency codes and standards are needed for whole buildings and for equipment and appliances, as are incentives and tax reform measures to advance the infrastructure necessary to support new "smart" and highly-efficient technologies and distributed generation. Finally, the legislation should create separate incentives for regulated entities, building owners, and other parties not subject to the cap to go even further in producing energy efficiency savings.

Policies are needed to realize the full potential of energy efficiency as a high priority energy resource and a cost-effective means of reducing GHG emissions.

International Engagement and Linkage

While taking the necessary first step of placing limits on our own emissions, Congress should strongly urge the Administration to safeguard U.S. interests by engaging in international negotiations with the aim of establishing commitments by all major emitting countries. The post-2012 global framework should establish international GHG markets, assist vulnerable populations in adapting to climate impacts, and boost support for climate-friendly technology in developing countries.

OUR COMMITMENT



We, the members of the U.S. Climate Action Partnership, pledge to work with the President, the Congress, and all other stakeholders to enact an environmentally effective, economically sustainable, and fair climate change program consistent with our principles at the earliest practicable date.

APPENDIX

U.S. Climate Action Partnership Members

Alcan Inc.



Alcoa

American International
Group Inc. (AIG)



Boston Scientific Corporation



BP America Inc.



Caterpillar Inc.



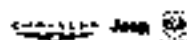
ConocoPhillips



The Chrysler Group



Dodge & Company



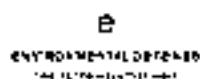
The Dow Chemical Company



Duke Energy



DuPont



Environmental Defense



Exelon Corporation



Ford Motor Company



FPL Group, Inc.

General Electric

General Motors Corp.

Johnson & Johnson

Marsh, Inc.

National Wildlife Federation

National Resources
Defense Council

NRG Energy, Inc.

The Nature Conservancy

PepsiCo

Pew Center on Global
Climate Change

PG&E Corporation

PNM Resources

Rio Tinto

Shell

Siemens Corporation

World Resources Institute

Xerox Corporation

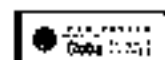


Johnson-Johnson

MARSH



The Nature
Conservancy



PG&E Corporation

PNM Resources

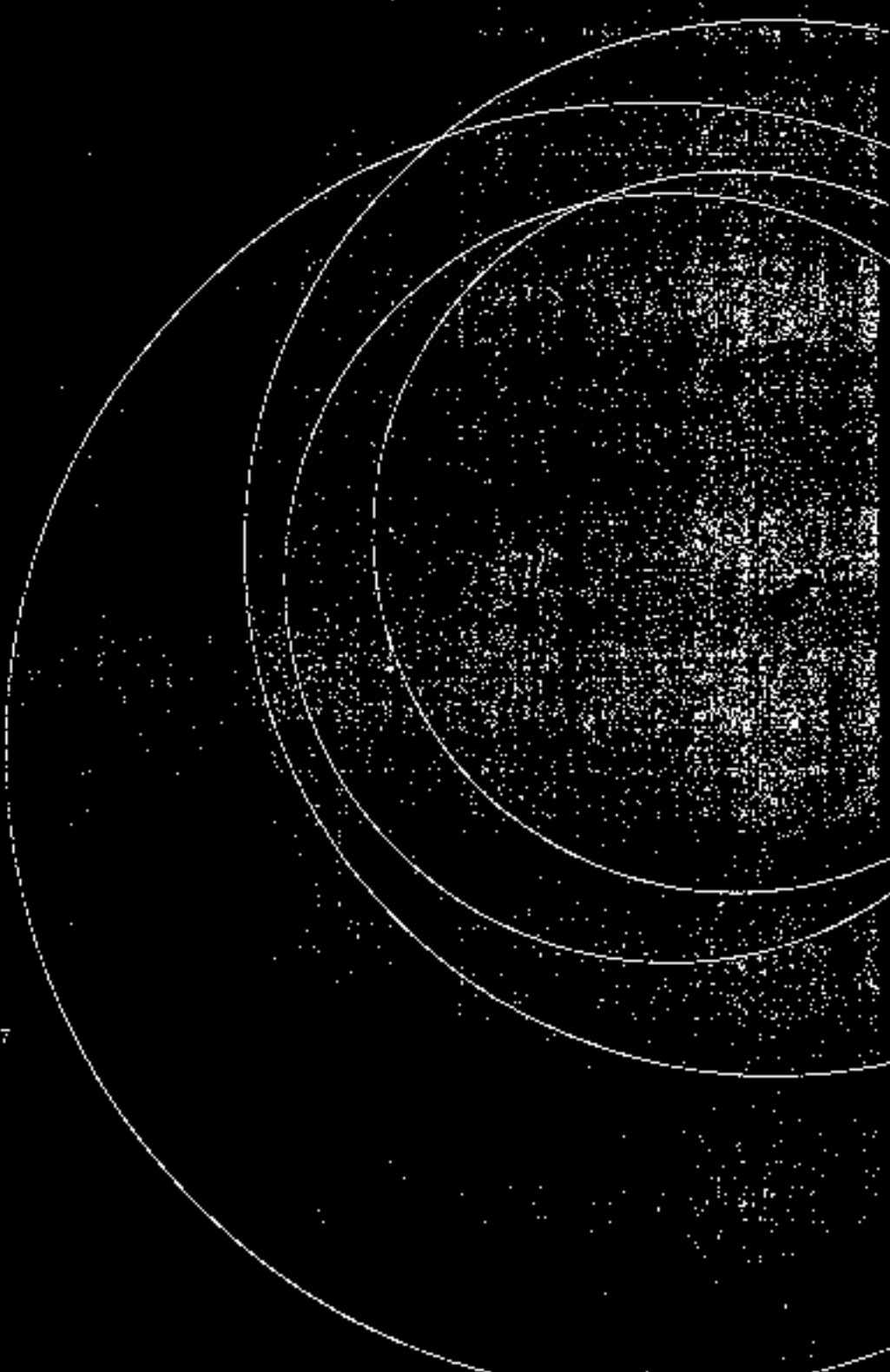
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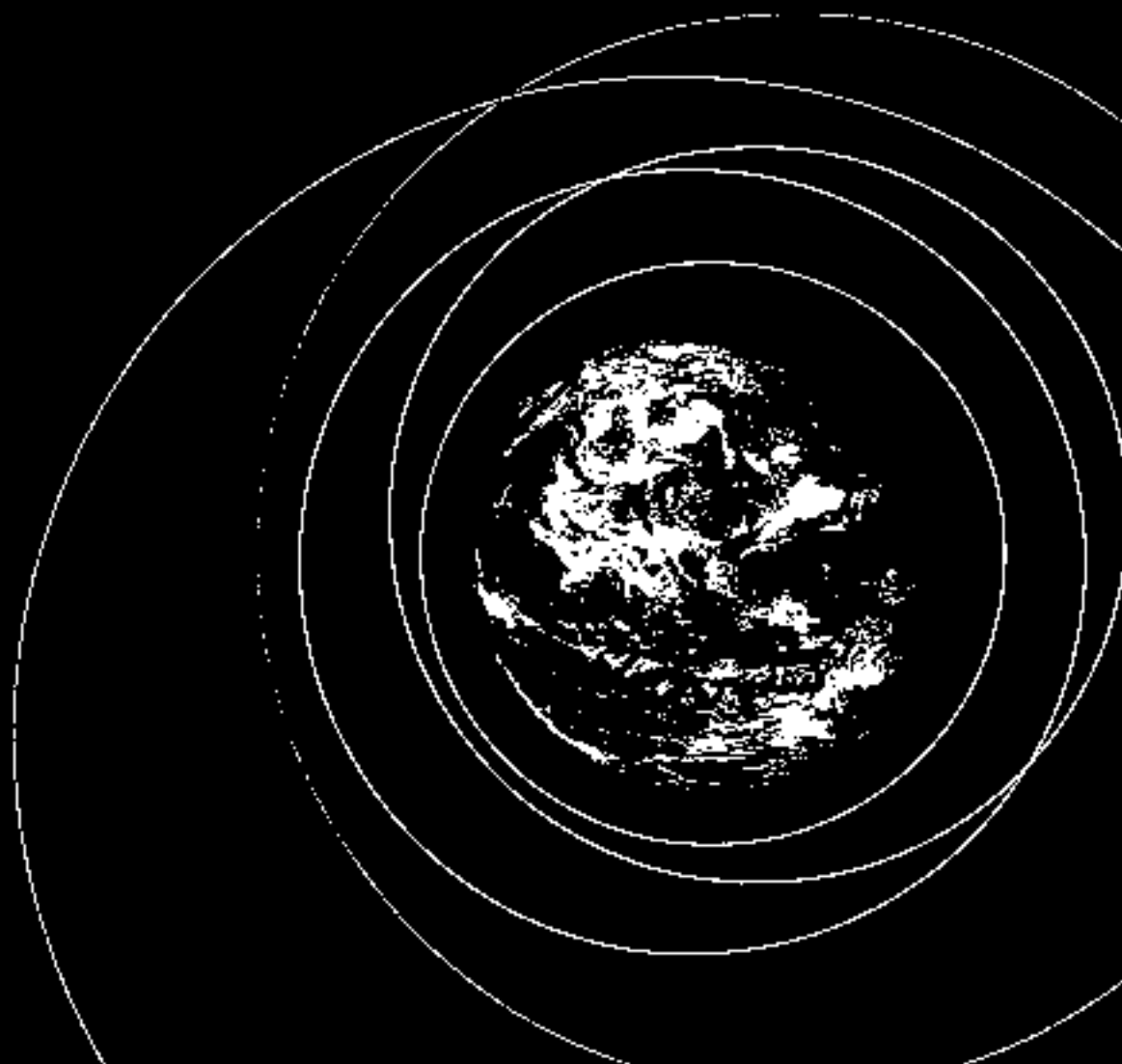
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The members of the USCAP wish to acknowledge the
valuable assistance provided by the Meridian Institute in guiding
and facilitating our discussions leading to this important agreement.



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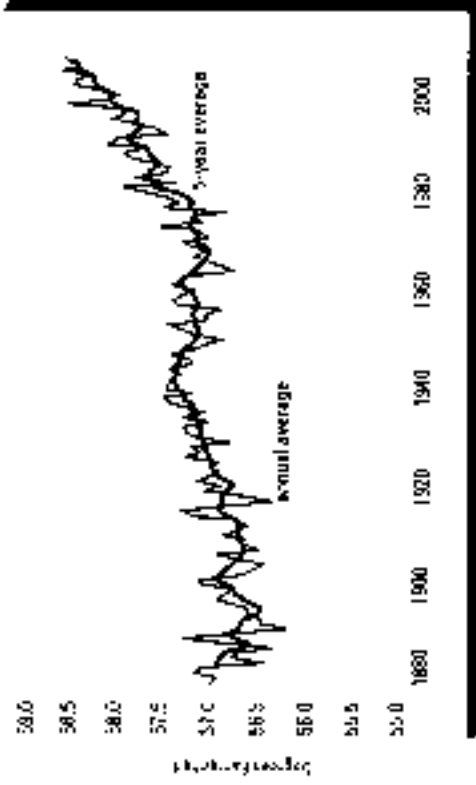


FSC

Introduction and Summary

Figure 1

Average Global Temperature, 1880 - 2007



Source: Susan Solomon and Institute for Space Studies (2005)

Background

Climate change has become a critical issue affecting the future of Southern California and the entire global community. Assessments from the international and national scientific communities, notably the Intergovernmental Panel on Climate Change (IPCC) and the National Academy of Sciences, have

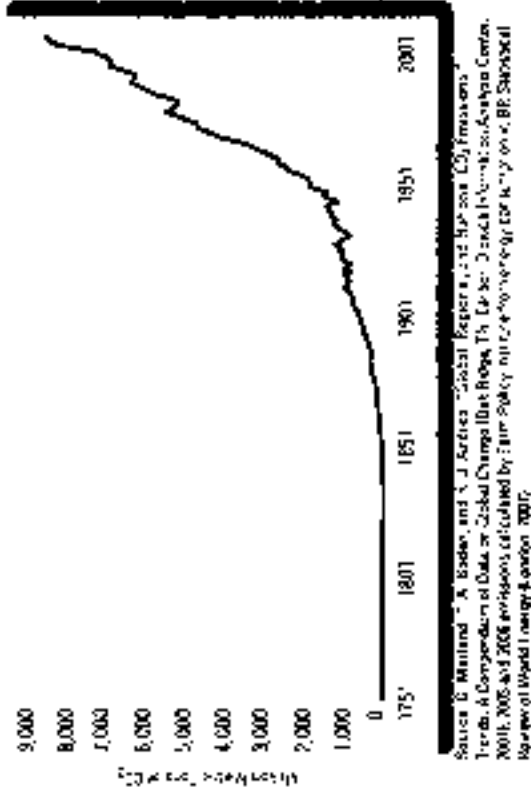
found that the Earth has been warming at an accelerated pace. In addition to warming temperatures, recent changes in a large number of other measures have been linked to climate change.

Since the beginning of the 20th century, average global temperatures have already risen 1.4° F, with much of the warming occurring within the last 30 years (Figure 1).¹ The year 2005 was Earth's warmest year followed by 2003, and the fourteen warmest years on record have all occurred since 1990. Looking forward, temperatures will likely rise at least another 2° F, and possibly more than 11° F by the end of the 21st century.²

Since the beginning of the Industrial Revolution, increasing greenhouse gas (GHG) emissions due to human activities, particularly the use of fossil fuels, have led to a marked increase in atmospheric GHG concentrations that absorb the heat. These GHGs, predominantly (77 percent) carbon dioxide (CO₂), also include methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). GHGs are not quickly purged from the atmosphere. CO₂ has a residence time of more than 100 years. So the effects of high GHG emissions on the Earth's climate will be felt for several decades into the future. Between 1750 and 2006, annual global CO₂ emissions from fossil fuel burning increased from 5 million metric tons to 8.4 billion metric tons (Figure 2). In particular, annual global CO₂ emissions from fossil fuel burning since 1950 have increased more than 5 times, from 1.6 billion metric tons to 8.4 billion metric tons.

Figure 2

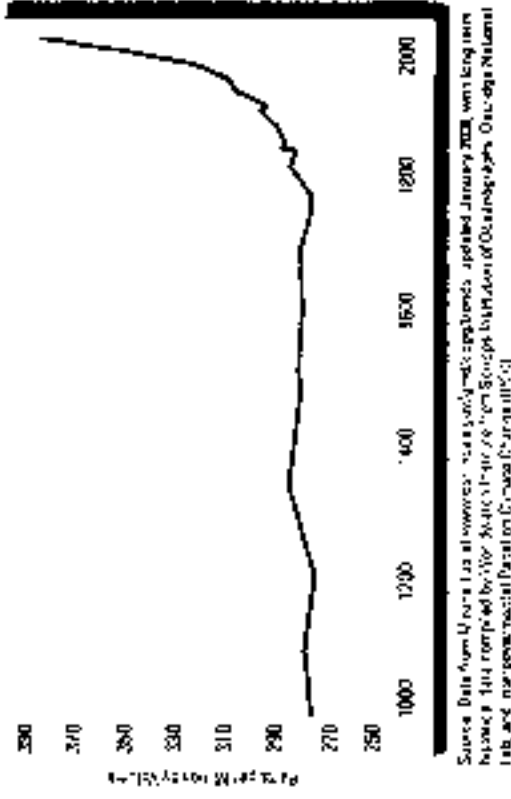
Annual Global Carbon Dioxide Emissions from Fossil Fuel Burning, 1751-2006



In 2007, the atmospheric concentration of CO₂ was 384 parts per million (ppm), up from 277 ppm at the start of the Industrial Revolution in 1750 (Figure 3). During the same period, the atmospheric concentration of both methane and nitrous oxide, two other greenhouse gases, also increased significantly due to human activities.³ Between 2000 and 2007, atmospheric CO₂ concentration grew by an average of 2 ppm per year, the fastest seven-year increase since continuous monitoring began in 1959.

Figure 3

Atmospheric Concentration of Carbon Dioxide, 1000 - 2007



Global warming poses a serious threat to the economic well-being, public health and natural environment in Southern California and beyond. The potential adverse impacts of global warming include, among others, a reduction in the quantity and quality of water supply, a rise in sea levels, damage to marine and other ecosystems, and an increase in the incidences of infectious diseases. According to climate scientists, California and the rest of the developed world will have to cut GHG emissions by 80 percent from today's levels to stabilize the amount of GHG emissions in the atmosphere and prevent the most severe effects of global climate change.⁴

California Context

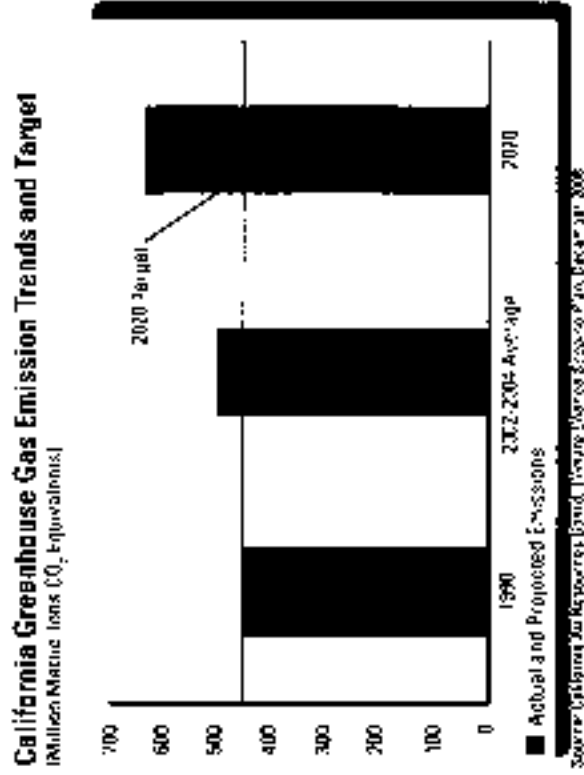
In 1990, California generated 427 million metric tons of CO₂ equivalents (MMTCE) of GHG emissions that increased to reach 469 MMTCE, based on the average between 2002 and 2004. It is projected to further increase to 596 MMTCE in 2020 without changes in mitigation efforts. GHG emissions generally track closely with trends in energy use, adjusting for changes in fuel mix and the relative carbon intensity of the various fuels. In 2004, the transportation sector accounted for 38 percent of the total GHG emissions, followed by electricity (25 percent), industry (20 percent), commercial and residential (9 percent), agricultural (6 percent), and others.

California is the most populous state in the nation. Despite its achievement in energy efficiency and less carbon-intensive energy use relative to other states, California is second only to Texas in the nation in terms of total GHG emissions, and is the 15th largest source of climate change emissions in the world, exceeding most nations. The SCAAC region, with close to half of the state's population and economic activities, as an important contributor to the global climate change problem and should also be an important contributor to its solution.

In 2006, state legislation Assembly Bill No. 32 (AB 32), the California Global Warming Solutions Act, passed into law requiring that statewide GHG emissions be reduced to 1990 levels by 2020 (Figure 4). This would represent reducing about 30 percent from business-as-usual emission levels projected for 2020. On December 1, 2008, the California Air Resources Board (ARB) adopted a comprehensive Scoping Plan outlining the state's strategy to achieve the 2020 GHG emission reduction target. Senate Bill No. 375 (SB 375), effective January 2009, also intends to implement a small portion of AB 32 to reduce the GHG emissions from

the use of autos and light trucks through land use and related policies. Furthermore, as a long-term goal, Governor's Executive Order (S-3-05) requires that by 2050 reducing the GHG emissions to 80 percent below the 1990 level.⁵

Figure 4



Considerations in Selecting Essay Topics

The scope of the climate change issue is very broad and encompasses planning (e.g. land use, transportation, energy, water, ecosystem and human health), financing, technology, policy, legislation, etc. In addition to state and federal leadership and international cooperation, to effectively address

the climate change challenges requires truly integrated regional planning linked with local implementation.

For this essays publication, the focus is on the scenarios and impacts of climate change in Southern California and potential responses in the region to contribute to the climate change solutions. Because there are many uncertainties involved in so many different aspects of the climate change problem, identifying with confidence a single outcome or pathway is not possible. Thus, it is important to consider a set of possible scenarios.

Pertinent scenarios involve not only the range of possible climate changes and their impacts, but also combined impacts with other looming stresses, such as the limit that will be imposed by peak oil that will develop along with an increasingly changing climate. Topics of response strategies covered include integrating land use/transportation planning, green buildings, education and workforce development for a green economy, governance and financing policies, and integration with larger sustainability goals. Most of the response strategies are applicable for local government in the region.

It should be noted that response strategies discussed are illustrative in nature and are not intended to be comprehensive. In addition, they focus on mitigating the potential climate change impacts and not on adaptation strategies. Given certain climate change impacts will be unavoidable, adaptation strategies will also be needed.

Summary of the Essays

The seven issue essays included in this publication address different dimensions of the climate change challenges, solutions and opportunities.

In "What Should Southern California Prepare for?" Dr. Dan Cayan outlines

the range of climate changes in the region and their potential impacts. It is noted that temperature in Southern California by 2100 will likely rise by 4°F, and greater warming, as much as 10°F or more is possible, if greenhouse gas emissions continue at a high rate. Amongst the pervasive effects of climate warming are that the number of days with high ozone conditions will markedly increase. Warmer temperatures might require the implementation of additional emission controls in order to offset this climate change. Also, heat waves will likely intensify and last longer.

Southern California's annual receipt of precipitation is some of the most variable in the world, so we only occasionally see a "normal" year. This volatility, combined with warmer temperatures and a strong possibility of a shift to overall drier conditions, makes us especially vulnerable to climate change. Additionally, Northern California's water supply challenges will be affected by changes that occur beyond the region in the Sierra Nevada and Colorado River Watersheds. By 2050, sea levels along Southern California's coast, relative to its 2000 level, could rise as much as one foot, and by 2100 they could rise 1.5 feet to 4 feet above the 2100 level.

Mr. Bryn Davidson's essay "Peak Oil and Climate Change: Scenarios and Implications" focuses on the nexus of climate change, peak oil and planning.

Though climate change and peak oil have uncertainties, both were founded on a largely undeniable central message: the future may be very different from the past. Mr. Davidson explores how these two powerful forces might combine to change the way we build our cities and regions. He explains what we know about peak oil (including the growing gap between discovery and consumption). While in the long term, runaway climate change could have many times the impact of peak oil, in the near term, (say 1 to 20 years), peak oil's direct impact on the economy and on the price and availability of energy could be many times the direct local impact of either climate change or climate policy.

Given the uncertainty of both climate change and peak oil, Mr. Davidson defined plausible future scenarios encompassing the combined impacts of peak oil and climate change. In the "Techno-Markets" scenario, the market, after several years of turbulent transition, responds to energy shocks, carbon cap and carbon pricing with new high-tech technologies that scale up quickly. In the "Lean and Loyal" scenario, combined energy, economy, and climate shocks detail both the economy and local culture for climate change. Technological adaptation (in fuel shortages and a more chaotic climate) is limited by the stagnant global economy. Government rationing is common. Local and low-tech community-based solutions predominate. These two scenarios are contrasted with the "Fast Track" scenario which embodies many of the assumptions still used by many people today.

The scenario-based planning approach not only identifies the combined impacts of peak oil and climate change but also the policy strategies that would be most robust across scenarios. Those robust strategies must reduce both emissions and oil dependence through resilient investments. By prioritizing these strategies, we can create the backbone of a prosperous post-carbon economy and region.

The first two essays summarized above focus on the impacts and scenarios of climate change and set the stage for the other five essays to address response strategies. In "How Planning Can Combat Climate Change in Southern California," Mr. William Fulton reminds us that we would build on certain trends of the existing development patterns to address climate change. Specifically, we have to take advantage of the emerging pockets of urban concentration in the region, and to reshape certain parts of the region to be less dependent on automobiles.

He gives examples of relatively self-contained villages and dense communities.

The trick is to reinvigorate these villages and centers so that they have jobs, housing and retail in close proximity to one another – to the extent possible – knit these locations together with high speed public transit in the form of rail lines or bus rapid transit. Mr. Fulton then illustrates some of the tools to accomplish this goal including market opportunities, policy ideas and funding sources. Just as successfully reducing our carbon footprint requires a concentration of activities, successfully bringing these communities into existence requires a dense and focused concentration of policy, funding and marketing efforts.

Mr. Walker Wells addresses the effectiveness of green building programs which have become the cornerstone of climate action plans for local government. In "Green Buildings – A Tool for Steering Climate Change," he observes that green buildings integrate innovations in energy efficiency, water conservation, waste management, and use planning and public health. They are a long-term strategy to address climate change and the benefits increase exponentially as time goes by. While new green buildings have attracted the most attention, renovation and operation of existing buildings are also important. In the end, green buildings need to be combined with thoughtful land use planning and provision of resource-efficient transportation options to realize the full potential of the built environment to stem climate change.

Ms. Mona Field illustrates the effort of the Los Angeles Community College District (LACCD) in "Education for a Green Region: Community Colleges Tackle Climate Change and Economic Development through Green Curriculum and Sustainable Building." With the emerging green technology industries, it is important that we train a new generation of workers for a green economy. The District's green curriculum covers workforce development programs such as architecture, solar installation, alternative fuels, water supply, waste water, and sustainable construction.

In addition, LACCD is undergoing one of the largest public sector sustainable building efforts in the nation, with all new buildings being constructed to meet Leadership in Energy and Environmental Design (LEED™) standards. Also, through a Zero Landfill policy, approximately 98 percent of the District's construction surplus items are kept from reaching local landfills by selling, donating or recycling. Also virtually all of the newly purchased carpeting and furniture purchased by LACCD comes from manufacturers who use recycled materials in their products.

Dr. Dan Mazmanian and his colleagues propose a decision-making framework for investment – a triple bottom line – for the region. In “*Governance and Financing Policy in Southern California: Transformational Changes in Adaptive Climate Change Goals*,” he proposes that investment should be evaluated based on their performance with respect to the environment, economy and equity. Dr. Mazmanian found that Southern California's unprecedented climate change and energy supply challenges are potentially dire, yet they also provide an opportunity for Southern California to emerge as a national model for how to meet them.

Transformation of existing governmental and financing structures will be an essential part of meeting the region's challenges, with lasting benefits in the provision of major infrastructure and public service projects for decades to come. In moving the region forward, it will be essential that a “Triple Bottom Line” (TBL) approach be adopted that combines economic growth, environmental and health safeguards, and an improved quality of life for all the people of the region as the ultimate gauge of the region's prosperity.

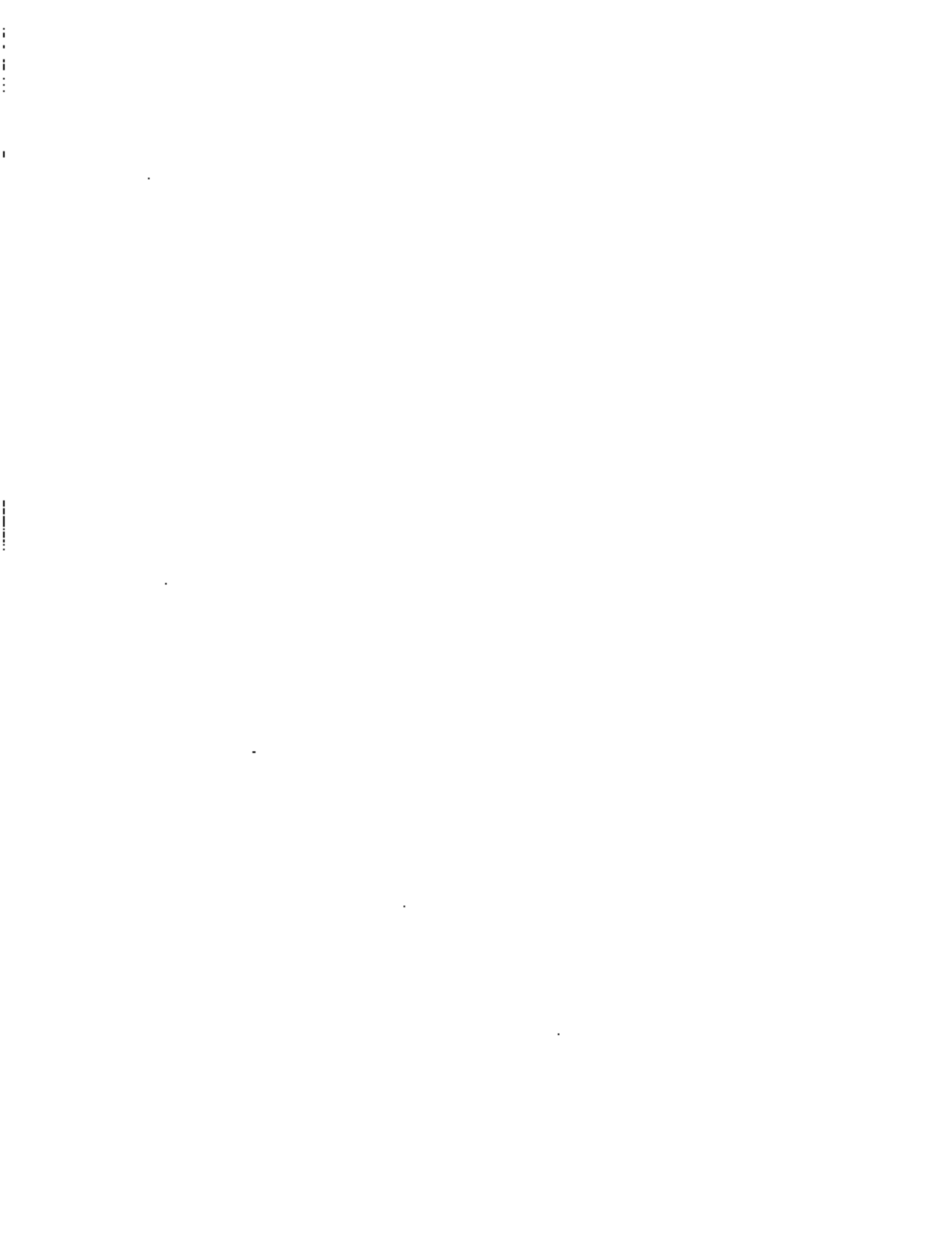
In “*Climate Disruptions: Searching for Sustainability in Southern California*,” Dr. Mosely Tenapel acknowledges that it is too late to stop the climate “train,” but slowing it down is paramount. Southern California will experience the impacts not only from within the region but also through its global

connections. He reminds us that never before has the urgency of a global problem aligned so closely with local transformation. He points out that regional institutional capacities and shared community visions are central to the implementation of “global” climate solutions. Actions at the regional and local levels to curb greenhouse gas emissions will have significant co-benefits in contributing to the sustainability of our regional community and beyond for our children and grand-children.

Finally, to further support implementation activities to address climate change impacts, SCAG staff also prepared two informational pieces to complement the issue essays. The first piece provides an overview of two climate change legislations in California, AB 32 and SB 375 due to its particular relevance to local government. The other piece provides additional resources on best practices to address climate change.

Endnotes

1. The National Academies, 2008. *Understanding and Responding to Climate Change - Highlights of National Academies Reports*.
2. Intergovernmental Panel on Climate Change (IPCC), 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, p. 13. Cambridge University Press.
3. *Ibid.*, p. 3.
4. California Air Resources Board, 2008. *Climate Change Scoping Plan*.
5. See Section on Overview of AB 32 and SB 375 in this publication for additional background information.





INSTITUTE FOR LOCAL GOVERNMENT

CALIFORNIA CLIMATE ACTION NETWORK

BEST PRACTICES FRAMEWORK

VERSION 5.0 – MAY 9, 2008

THE FRAMEWORK SUPPORTS YOUR EFFORTS NOW

This Best Practices Framework offers suggestions for local action in ten Climate Leadership Opportunity Areas (see right), both in agency operations and the community at large. An agency can use specific best practice suggestions for stand-alone programs or as part of a broad-based climate action plan to reduce greenhouse gas emissions. The suggestions are designed to reflect the variation among cities and counties and offer a variety of options ranging from simple steps to more complex undertakings.

Climate Leadership Opportunity Areas

- | | |
|---------------------------------------|---|
| 1. Energy Efficiency and Conservation | 6. Renewable Energy and Low-Carbon Fuels |
| 2. Water and Wastewater Systems | 7. Efficient Transportation |
| 3. Green Building | 8. Land Use and Community Design |
| 4. Waste Reduction and Recycling | 9. Storing and Offsetting Carbon Emissions |
| 5. Climate-Friendly Purchasing | 10. Promoting Community and Individual Action |

YOU CAN START NOW

We encourage you to review the Framework and get started on those actions that make sense for your agency. Many ideas in the Framework can be implemented immediately, even if you don't have a climate action plan. For example, you can audit agency buildings and operations to find ways to save energy and money, such as by replacing lights, inefficient HVAC systems or water pumps. Buying climate-friendly products are another option. Check the Framework for ideas you haven't thought of – if it fits your agency or community, you can start today.

DEVELOP A BROAD-BASED CLIMATE ACTION PLAN

Strategies for reducing greenhouse gases often overlap more than one program area. For example, many practices that improve energy efficiency also can apply to green building and water conservation. Strategies to promote efficient transportation are related to land use and community design. You can use the Framework to help identify these overlaps and start developing a broad-based climate action plan for your community.

SEND US YOUR FEEDBACK

The Best Practices Framework is an evolving resource document. Over time, we will include new actions that reflect innovation at the local level. If your city or county has additional suggestions for best practices to share, please send them to us, along with any background information available. Email: climatechange@ca-ilg.org

If you would like to receive information about climate change resources and updates from CCAN, please visit www.ca-ilg.org/climate/listserv to be added to the CCAN listserv.

The California Climate Action Network provides information, tools and resources in support of local governments' efforts to reduce greenhouse gas emissions in their communities. The California Climate Action Network is a program of the Institute for Local Government, the non-profit research and education affiliate of the League of California Cities and the California State Association of Counties. Visit the California Climate Action Network Web site at www.ca-ilg.org/climatechange.

Energy Efficiency and Conservation

GOAL	BEST PRACTICE
<p>Energy conservation and efficiency in agency buildings and equipment.</p> <p><i>See also Green Building section for additional energy options.</i></p>	<p><i>Audit/evaluation</i></p> <ul style="list-style-type: none"> • Audit major agency buildings and facilities to quantify energy use and identify opportunities for energy savings through efficiency and conservation measures. • Conduct retro-commissioning studies of major agency building HVAC and lighting systems. • Benchmark energy use of major agency buildings. <p><i>Building retrofitting and retro-commissioning</i></p> <ul style="list-style-type: none"> • Develop an implementation schedule to implement no cost/low cost opportunities. • Develop implementation plan for capital intensive energy retrofits. • Develop implementation plan to achieve facility Energy Star rating of 50-75 or greater, where feasible. • Implement retro-commissioning improvements as recommended in studies. <p><i>Operations/protocols</i></p> <ul style="list-style-type: none"> • Establish energy efficiency protocols for building custodial and cleaning services. • Establish facility energy efficiency policy for employees that provides guidelines, instructions and requirements for efficient use of the facility such as by turning lights and computers off, thermostat use, etc. • Implement off-peak scheduling of pumps, motors and other energy intensive machinery where feasible. • Incorporate energy management software or other methods to monitor energy use in agency buildings. <p><i>Standardize/commissioning</i></p> <ul style="list-style-type: none"> • Develop commissioning and retro-commissioning standards for new and renovated buildings. • Develop and implement shading requirements for agency and community parking lots, buildings and other facilities to reduce the urban heat island effect. • Develop and implement a continuous commissioning plan. • Integrate energy efficiency, conservation, solar and other renewable energy technologies into new agency facilities. <p><i>Work with energy provider</i></p> <ul style="list-style-type: none"> • Work with energy provider to access utility's technical assistance and financial incentives.

Energy Efficiency and Conservation

GOAL	BEST PRACTICE
Reduce energy use for traffic signal and street lighting system.	<ul style="list-style-type: none">• Replace incandescent traffic and crosswalk lights with energy-efficient light-emitting diodes (LEDs).• Replace incandescent and mercury vapor street and parking lot lights with energy efficient alternatives.
Outreach to business and residents to promote energy efficiency in the community.	<ul style="list-style-type: none">• Encourage community businesses to conduct energy audits.• Work with energy provider to encourage commercial sector to install energy efficient exterior lighting that is appropriate for the location and use, considering security versus decorative lighting.• Require energy audits and/or retrofits, such as at time of sale of commercial and residential properties. • Work with energy provider to promote use of financial incentives to assist residential and commercial customers improve energy efficiency.• Promote and reward energy efficiency efforts of local retail businesses.• Collaborate with local retail businesses to encourage residents to purchase energy efficient products.

Water and Wastewater Systems

GOAL	BEST PRACTICE
<p>Reduce energy use in water, irrigation and waste water systems (either operated by agency or by another agency or private company).</p> <p><i>See also Green Buildings section for additional options.</i></p>	<ul style="list-style-type: none"> • Audit agency's water and waste-water pumps and motors to identify most and least efficient equipment. • Develop and implement a motor/pump efficiency cycling schedule to use most efficient water or waste-water motors/pumps first and least efficient ones last. • Replace least efficient water/wastewater motors and pumps with more efficient units. • Work with agency or company that provides water and waste water service to implement an audit, cycling and equipment replacement program for water and waste water pumps and motors. • Implement methane capture for energy production at wastewater treatment plants. • Use recycled water for agency facilities and operations, including parks and medians, where appropriate. • Retrofit existing agency buildings and facilities to meet standards for the LEED Standards Rating Systems for Existing Buildings (EB) or Commercial Interiors (CI) • Require dual plumbing for use of recycled water for new commercial and/or residential developments
<p>Reduce water use in agency operations and in the community.</p> <p><i>See also Green Building section for additional options.</i></p>	<p><i>Agency operations</i></p> <ul style="list-style-type: none"> • Assess, maintain and repair existing plumbing fixtures, pipes, and irrigation systems in all agency buildings and facilities to minimize water use, including building and parking lot landscaping, public rest rooms and parks, golf courses and other recreational facilities. • Upgrade and retrofit agency plumbing and irrigation systems with state-of-the-art water conserving technology. • Implement all feasible water efficiency strategies included in the Anwahnee Water Principles for Resource Efficient Land Use in all agency parks, landscaping and in new developments. <p><i>Community at large</i></p> <ul style="list-style-type: none"> • Adopt water efficiency principles similar to the Anwahnee Water Principles for Resource Efficient Land Use for new and existing residential and commercial developments. • Implement water conservation and reclamation programs to reduce energy use associated with water delivery. • Require water efficiency audits at point of sale for commercial and residential properties. • Adopt retrofit program to encourage or require installation of water conservation measures in existing businesses and homes. • Partner with water provider to adopt water conservation measures

Green Building

GOAL	BEST PRACTICE
<p>Establish minimum levels of energy efficiency and green building standards for agency buildings and facilities.</p> <p><i>See also Energy Efficiency and Conservation section for more options.</i></p>	<ul style="list-style-type: none"> • Require that agency buildings have a performance equivalent to an Energy Star rating of at least 60-75 (as described in the LEED-E3 reference guide), where feasible. • Require all new agency buildings and facilities to meet at least LEED Silver certification standards. • Require renovated agency buildings and facilities and those using agency funds or other financial support to meet at least LEED Silver certification standards.
<p>Establish and implement minimum levels of energy efficiency and green building standards for commercial and residential buildings.</p> <p><i>See also Energy Efficiency and Conservation section for more options.</i></p>	<ul style="list-style-type: none"> • Require new residential and commercial construction to exceed Title 24 energy efficiency standards to extent permitted by law. • Provide technical assistance, financial assistance, and other significant incentives to private development projects that meet or exceed LEED Silver certification standards for commercial buildings. • Adopt and implement a local green building ordinance or program setting minimum standards of LEED Silver certification for new commercial, industrial and high-rise residential building projects. • Adopt and implement a local green building ordinance or program to require new low-rise residential construction to meet minimum green building standards, such as Build It Green, California Green Builder, LEED, or a similar program. • Provide technical assistance, financial assistance, and other significant incentives to private development projects that meet or exceed specified standards under green building programs such as Build It Green, California Green Builder, LEED, or a similar program. • Work with commercial developers to incorporate materials and furnishings made from recycled content.
<p>Implement sustainable landscaping</p> <p><i>See also Water and Wastewater section for more options.</i></p>	<ul style="list-style-type: none"> • Develop and implement sustainable landscaping standards for public agency facilities to reduce water consumption. • Develop and implement sustainable landscaping standards for new commercial construction and renovation to reduce water consumption. • Develop and implement sustainable landscaping standards for new residential construction and renovation to reduce water consumption.

Waste Reduction and Recycling

GOAL	BEST PRACTICE
<p>Enhance existing waste reduction and recycling activities at agency buildings and in the community.</p>	<ul style="list-style-type: none"> • Institute a comprehensive waste reduction and recycling program in agency offices and facilities. • Institute a partnership with other public agency offices located within the jurisdiction for waste reduction and recycling at those facilities. • Adopt a partnership with local schools for waste reduction and recycling. • Increase opportunities for e-waste and hazardous waste recycling by residents and businesses. • Educate the community about "buy recycled" opportunities. • Evaluate current community recycling infrastructure relative to future population growth and waste generation. • Include provisions and incentives for new recycling infrastructure and facilities to accommodate growth, in land use planning and zoning.
<p>Implement source reduction, recycling and resource recovery programs for waste organic material. Produce compost, mulch, energy and fuels from organic waste stream.</p>	<ul style="list-style-type: none"> • Audit agency facilities to identify opportunities to increase material recovery and beneficial use of organic material. • Establish an organic material recovery program for green waste from agency parks and facility landscaping. • Establish a program to use the maximum amount as possible of organic waste generated within the jurisdiction to produce compost and/or biofuel, including use on agency parks and landscaping. • Establish incentives for residents to participate in green waste recycling programs. • Adopt a restaurant food waste collection program or ordinance. • Approve siting of composting facility within jurisdiction
<p>Reduce office and commercial waste and increase recycling.</p>	<ul style="list-style-type: none"> • Adopt a program or ordinance to encourage or require recycling at multi-family apartments. • Adopt a program or ordinance to encourage or require recycling in the commercial/industrial sectors. • Adopt a program or ordinance to encourage or require waste audits and waste reduction plans for existing and/or new commercial developments. • Audit major waste generators and recommend strategies to reduce waste and increase recycling. • In partnership with the waste hauler(s) serving the commercial sector, institute a comprehensive waste reduction and recycling program with financial and other incentives to promote waste reduction and recycling for commercial/industrial waste generators. • Partner with the California Integrated Waste Management Board to encourage businesses and residents to participate in CalMax (California Materials Exchange) or a similar program.

Waste Reduction and Recycling

GOAL	BEST PRACTICE
Source reduction, recycling and resource recovery programs for construction and demolition material.	<ul style="list-style-type: none">• Require all agency demolition projects to incorporate de-construction and construction and demolition waste recycling or recovery practices.• Adopt a program or ordinance to reduce, reuse and recycle community construction and demolition waste• Adopt a "deconstruction" program or ordinance to salvage and reuse materials in all community remodeling projects. • Adopt and implement a policy to require use of rubberized asphalt concrete (RAC) for streets and roads• Adopt and implement a policy to require use recycled asphalt pavement (RAP) for streets and roads.• Implement a policy to use RAP for commercial and community parking lots, where feasible • Encourage schools and other public agencies to use RAP for parking lots, where feasible.• Establish a program or ordinance that results in 100 percent in-place recycling of asphalt concrete.• Establish a program or ordinance that results in recycling of 100 percent of all Portland cement and asphalt concrete.
Decrease carbon footprint of jurisdiction's waste and recycling collection system.	<ul style="list-style-type: none">• Work with solid waste and recycling collection providers to calculate carbon footprint of collection system.• Work with solid waste and recycling collection providers to reduce collection system footprint.

Climate-Friendly Purchasing

GOAL	BEST PRACTICE
<p>Commit to purchasing specific products and goods that are climate-friendly.</p> <p><i>See also Waste Reduction and Recycling and Green Building sections.</i></p>	<ul style="list-style-type: none"> • Adopt and implement a procurement policy that establishes standards for climate-friendly products and requires agency purchases to meet such standards as: <ul style="list-style-type: none"> ◦ New equipment meets Energy Star or comparable energy efficiency standards. ◦ Computer purchases meet the highest feasible EPEAT certification level. ◦ Office paper purchases (copy paper, printer paper, writing pads, stationery, envelopes and business cards) contain a minimum specified percentage of post consumer recycled content. ◦ Other paper purchases (paper towels, toilet paper, napkins and similar items) contain a minimum percentage of post consumer recycled content. ◦ Carpeting and other furnishings contain a minimum percentage of recycled content. ◦ Plastic items (refuse and recycling receptacles, decking, parking lot barriers, furniture, etc.) contain recycled content. ◦ Oil and oil-related products contain recycled content. ◦ Products certified by either GreenSeal or EcoLogo, as long as they cost no more than an agency-determined percentage above the price of non-certified products. • Create an interdepartmental team to 1) promote policy implementation, 2) track policy adherence, and 3) suggest additional items to be included in the agency's climate-friendly purchasing program, including such tasks as: <ul style="list-style-type: none"> ◦ Reviewing and analyzing current (baseline) purchasing by major product categories. ◦ Prioritizing product categories in terms of greenhouse gas emissions implications and improvement potential. ◦ Reviewing policies, procedures, organization/staffing for implementation barriers. ◦ Developing multi-year implementation schedule based on priorities, difficulty, upcoming solicitations. ◦ Reporting achievements under the policy to policy makers and the public annually.

Climate-Friendly Purchasing

GOAL	BEST PRACTICE
Purchase services that are climate-friendly.	<ul style="list-style-type: none"> • Require service providers to follow climate-friendly practices, or provide a preference in selecting and contracting with service providers to those that follow climate-friendly practices. • Provide incentives for the use of alternative fuel vehicles for agency contracts for services involving vehicles (buses, waste hauling and recycling, construction, etc.). • Ensure that the highest feasible percentage of annual expenditures for contract services is with companies registered with the California Climate Action Registry or its successor.
Give a preference to climate-friendly vendors.	<ul style="list-style-type: none"> • Provide a price preference to product vendors that follow climate-friendly practices, including use of recycled content materials, Energy Star and EPEAT materials and equipment, as well as alternative fuel vehicles. • Provide a price preference to product vendors that inventory and register their greenhouse gas emissions with the California Climate Action Registry or its successor and that report their verified greenhouse gas emissions within the jurisdiction.
Community education about climate friendly procurement.	<ul style="list-style-type: none"> • Educate the public about climate friendly procurement opportunities. • Work with the business community to educate them about climate friendly procurement opportunities.

Renewable Energy and Low-Carbon Fuels

GOAL	BEST PRACTICE
<p>Promote agency use of fuel efficient and alternative fuel vehicles to reduce reliance on fossil fuels.</p> <p><i>See also Efficient Transportation section.</i></p> <p>Promote methane recovery programs and projects.</p> <p><i>See also Waste Reduction and Recycling section.</i></p>	<ul style="list-style-type: none"> • Convert vehicles owned, leased or operated by the agency to run on alternative fuels or other non-fossil fuel based technology that significantly reduces greenhouse gas emissions. • Install bicycle racks, showers and other amenities at agency facilities to promote bicycle use by agency employees and visitors.
<p>Promote the use of renewable sources of energy.</p>	<ul style="list-style-type: none"> • For jurisdictions that own or operate one or more landfills, recover and use the maximum feasible amount of recoverable methane gas from the landfill to produce electricity, fuel co-generation facilities, and/or produce CNG for use in alternative fuel vehicles. • For jurisdictions that do not own or operate landfills, calculate the methane emissions associated with the disposal of waste generated within the community. • For jurisdictions that do not own or operate landfills, enter into partnerships or agreements with waste disposal agencies or companies to ensure that the maximum feasible amount of methane is recovered for waste-to-energy purposes. • Install digesters and other technologies at wastewater treatment facilities to produce methane and other biofuels.
<p>Promote the use of renewable sources of energy.</p>	<ul style="list-style-type: none"> • Install photovoltaic systems or other renewable sources of energy on agency facilities OR enter into power purchasing agreements to meet at least 10-25 percent of the electrical energy requirements of facilities owned, leased or operated by the agency. • Adopt policy or program that offers incentives, such as streamlined permitting system or fee waivers, to encourage installation of photovoltaic systems on new or existing residential and commercial buildings.

Efficient Transportation

GOAL	BEST PRACTICE
Implement transportation planning processes that reduce automobile dependency.	<ul style="list-style-type: none"> ▪ Update transportation models and surveys to capture data for and accurately reflect all modes of transportation. ▪ Make reductions in vehicle-miles traveled (VMT) a high-priority criteria in evaluation of policy, program and project alternatives. ▪ Implement transportation planning procedures that consider demand management solutions equally with strategies to increase capacity. ▪ Include all significant impacts (costs and benefits) in benefit-cost assessment of alternatives, including non-market or indirect impacts, such as improving mobility options or reducing air pollution and greenhouse gas emissions.
Improve infrastructure and Transportation Systems Management (TSM). <i>See also Land Use and Community Design section.</i>	<ul style="list-style-type: none"> ▪ Implement Intelligent Transportation Systems (ITS) for surveillance and traffic control, such as synchronized signals, transit and emergency signal priority, and other traffic flow management techniques, to improve traffic flow and reduce vehicle idling. ▪ Implement programs to reduce "incident-based" traffic congestion, such as expedited clearing of accidents from major traffic arteries, airport traffic mitigation, etc. ▪ Develop infrastructure improvements such as HOV/HOT lanes and dedicated bus rapid transit right-of-ways.
Reduce Idling.	<ul style="list-style-type: none"> ▪ Adopt and implement a policy requiring limitations on idling for commercial vehicles, construction vehicles, buses and other similar vehicles, beyond state law, where feasible.

Efficient Transportation

GOAL	BEST PRACTICE
<p>Promote alternatives to single-occupant auto commuting.</p> <p><i>See also Land Use and Community Design section</i></p>	<p><i>Agency operations</i></p> <ul style="list-style-type: none">• Provide agency employees with incentives to use alternatives to single-occupant auto commuting, such as parking cash-out, flexible schedules, transit incentives, bicycle facilities, ridesharing services and subsidies, and telecommuting.• Reduce greenhouse gas emissions from municipal fleet operations by purchasing or leasing high MPG, low carbon fuel or hybrid vehicles, or by using an external car sharing program in lieu of city/county fleet. <p><i>Community</i></p> <ul style="list-style-type: none">• Work with major employers in the community to offer incentives and services to increase the use of alternatives to single-occupant auto commuting (voluntary commute trip reduction programs).• Encourage and facilitate the development of car-sharing and other services that reduce the need to own a personal motor vehicle.• Develop and implement voluntary agreements for commute trip reduction programs for new commercial developments.• Provide parking preferences in public lots, garages and on-street spaces for residents who rideshare or use low-carbon fuel vehicles.• Implement variable ("congestion") pricing and other pricing mechanisms for parking facilities, to provide incentives and discourage single-occupant-vehicle and peak travel.• Dedicate revenues from fees and tolls to promote alternative transportation modes.

Land Use and Community Design

GOAL	BEST PRACTICE
<p>Create communities and neighborhoods that are attractive, safe and convenient for walkers and bicyclists.</p> <p><i>See also Efficient Transportation section.</i></p>	<ul style="list-style-type: none"> • Assess and report on pedestrian and bicycle conditions in existing communities and neighborhoods. • Develop a community-wide pedestrian and bicycle plan and capital program that maximizes the potential for residents to walk or bicycle within and between neighborhoods. • Require new commercial developments to install bicycle parking facilities and other cyclist amenities at a level commensurate with the number of employees or square footage. • Adopt and implement a community-wide pedestrian and bicycle plan. • Provide bicycle access to transit services on major transit corridors and other routes that may attract bicyclists, such as routes serving schools and colleges. • Install traffic calming devices and other measures to reduce traffic speeds and volumes and increase the safety and feasibility of bicycling and walking. • Implement design standards that require streets and sidewalks to be designed for multi-modal mobility and access, including walking and bicycling, to ensure that new development is designed, sited and oriented to facilitate pedestrian, bicycle and other mobility and access.
<p>Orient new development to capitalize on transit system investments and services.</p> <p><i>See also Efficient Transportation section.</i></p>	<ul style="list-style-type: none"> • Provide incentives and remove zoning and other barriers to mixed-use and higher intensity development at transit nodes and along transit corridors (existing and planned). • Require new development at transit nodes and along transit corridors to meet planning and design standards to generate, attract, and facilitate transit ridership as a condition of approval. • Integrate park-and-ride lots with multi-use facilities.
<p>Adopt policies that promote compact and efficient development in new and existing communities.</p> <p><i>See also Efficient Transportation and Green Building sections.</i></p>	<ul style="list-style-type: none"> • Inventory infill development sites. Plan, zone and provide incentives for new development and renovation of existing uses in identified infill areas. • Adopt and enforce land use ordinances and regulations that reduce greenhouse gas emissions. Examples include prioritizing mixed uses and infill development, and providing more transportation and housing choices. • Require new housing and mixed use developments be built to the LEED for Neighborhood Development (LEED-ND) standard or its equivalent. • Provide expedited application processing for development projects that meet climate change response policies.

Land Use and Community Design

GOAL	BEST PRACTICE
<p>Incorporate greenhouse gas emissions considerations into the General Plan and environmental review process.</p> <p><i>See also Efficient Transportation section.</i></p>	<ul style="list-style-type: none"> • Include a greenhouse gas reduction plan in the General Plan, or include within the General Plan a requirement for development and adoption of a greenhouse gas reduction plan. • Analyze impact of greenhouse gas emissions from land use and transportation sectors in the EIR prepared in connection with general plan updates. • Amend local CEQA guidelines to explain how analysis of greenhouse gas emissions will be treated, such as thresholds of significance. [NOTE: the California Air Pollution Control Officers Association has published recommendations at www.caapco.org.] • Analyze impacts of development projects on safety, availability and use of alternative transportation in CEQA documents.
<p>Establish planning processes that encourage reducing greenhouse gas emissions.</p> <p><i>See also Efficient Transportation section.</i></p>	<ul style="list-style-type: none"> • Develop and adopt a preferred “climate-friendly” land use and transportation scenario for future development to reduce vehicle miles traveled (VMT) through software tools such as the PLACE²S system developed by the California Energy Commission. • Incorporate land use and transportation policies in the General Plan, capital improvement program and other planning and spending documents, codes and ordinances to reflect the preferred “climate-friendly” land use and transportation scenario. • Implement a regional blueprint or other long-range, regional planning process to assess the climate impacts of future growth and develop a preferred regional climate-friendly growth scenario. • Involve emergency responders early and consistently in development of growth plans.
<p>Increase transportation choices.</p> <p><i>See also Efficient Transportation section.</i></p>	<ul style="list-style-type: none"> • Establish land use policies that support multimodal transportation systems and connection of modes to each other. • Require sidewalks in all new developments. • Plan and permit road networks of neighborhood-scaled streets (generally 2 or 4 lanes) with high levels of connectivity and short blocks • Zone for concentrated activity centers around transit service. • Coordinate planning and project approval procedures to increase collaboration between land use and transportation planning staff. • Cluster freight facilities near ports, airports and rail terminals. • Coordinate with regional efforts and neighboring jurisdictions to plan for and accommodate alternate modes.

Storing and Offsetting Carbon Emissions

GOAL	BEST PRACTICE
<p>Preserve and enhance forests, parks, street trees, open space and other natural systems that act as carbon “sinks.”</p>	<ul style="list-style-type: none"> • Inventory existing trees on property owned or managed by the agency and implement a management system to preserve and enhance the existing urban forest. • Manage parks, open space, recreational facilities and other natural areas owned or operated by the agency to ensure the long-term health and viability of trees and other vegetation. • Develop and implement a community-wide urban forestry management and reforestation program to significantly increase the carbon storage potential of trees and other vegetation in the community. • Steer new development away from open space and agricultural lands that provide natural carbon storage. • Partner with other agencies and non-profit organizations to protect natural lands in and adjacent to the community through acquisition, conservation easements or other long-term mechanisms.
<p>Promote local sustainable agriculture to reduce carbon emissions associated with food production, processing, and transport.</p>	<ul style="list-style-type: none"> • Promote the purchase of local and organic produce through farmers markets and other measures. • Enact a local food purchase policy for agency food purchases. • Promote conservation tillage and other agricultural practices to retain carbon fixed in soils.
<p>Offset carbon emissions through carbon credits or allowances.</p>	<ul style="list-style-type: none"> • Audit agency-sponsored events and activities to determine greenhouse gas emissions associated with the event/activity. • Achieve carbon neutrality at agency-sponsored events and activities through conservation, efficiency, alternative transportation, and the purchase of third-party verified emission reductions to offset carbon emissions. • Achieve carbon neutrality for major agency operations through conservation, efficiency, alternative transportation, and the purchase of third-party verified emission reductions to offset carbon emissions. • Create incentives for community organizations and residents to reduce their carbon use including the purchase of third-party verified emission reductions. • Purchase and retire third-party verified emission reductions to offset community-wide carbon emissions.

Promoting Community and Individual Actions

GOAL	BEST PRACTICE
<p>Promote individual actions to reduce greenhouse gas emissions and conserve natural systems that store carbon.</p>	<ul style="list-style-type: none"> • Survey businesses and residents to understand attitudes and behaviors related to climate change • Include information on actions that individuals can take to address climate change in local agency mailings, websites, and other communications. • Develop a community climate change education initiative that elicits participation from schools, museums, service groups, business organizations (such as local Chambers of Commerce), neighborhood and homeowner associations, and other community partners. • Identify and allocate resources to implement a community climate change education initiative, and establish an implementation timeline not to exceed five years. • Initiate implementation of the education and action plan. • Provide programs and/or incentives to individuals, groups, and businesses that adopt practices that reduce their carbon footprint.
<p>Promote cooperation among agencies and communities to reduce greenhouse gas emissions and conserve natural systems that store carbon.</p>	<ul style="list-style-type: none"> • Participate in inter-agency and inter-jurisdictional meetings to share information about climate change and best practices to reduce carbon emissions. • Create an inter-agency local or regional climate action partnership and/or action plan with one or more sister agencies or neighboring jurisdictions. • Initiate the regional action plan. • Participate in the development of a regional blueprint or other long-range planning process to assess the climate impacts of future growth and develop a preferred climate-friendly growth scenario. • Initiate a Community Climate Action Partnership with a Global Sister Agency.
<p>Provide opportunities for public engagement that will support successful implementation of climate change actions.</p>	<ul style="list-style-type: none"> • Organize and promote community dialogues that educate residents about climate change and its possible impacts on the community. • Develop informational material for residents about climate change and opportunities for individual action to reduce greenhouse gas emissions. • Use public involvement processes to develop recommendations from residents and businesses about the city or county's climate change action plan and actions the agency is taking to respond to climate change, such as through green building, energy conservation, efficient transportation, and other actions. • Provide opportunities for interested residents to stay engaged after the initial planning to help monitor and assess ongoing efforts and recommend plan adaptations as needed.