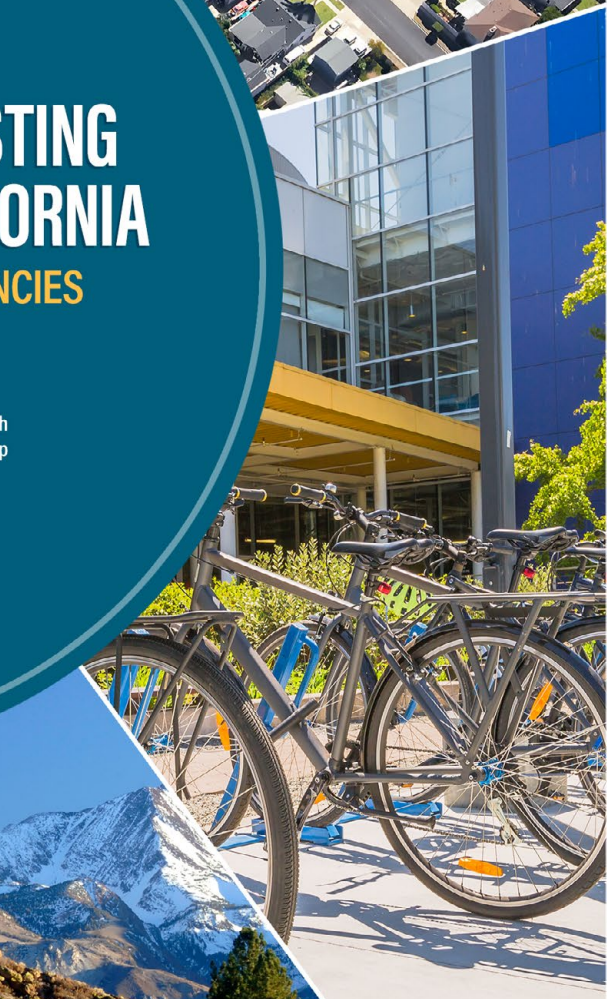
PLANNING AND INVESTING FOR A RESILIENT CALIFORNIA

A GUIDEBOOK FOR STATE AGENCIES

Prepared by the Governor's Office of Planning and Research
with the guidance and input of the Technical Advisory Group
formed under direction of Executive Order B-30-15



Acknowledgments

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Foreward

Why Prepare for a Changing Climate

Climate scientists have demonstrated that the earth's climate is changing. Without global action to reduce greenhouse gas emissions, the Earth will continue to warm, which will lead to impacts across all countries and regions.

This is not just an issue for the future. California is experiencing the effects of climate change now through an increase in the frequency and severity of extreme events and their associated significant costs to the government, Californians, and natural resources.

- The severity of California's 2012 – 2016 drought was exacerbated by climate change. In 2015 alone, researchers from the University of California at Davis estimated that the drought cost California $1.84 billion and led to the loss of over 10,000 jobs.[1]
- Scientists have concluded that climate change increases forest fire activity in the Southwestern United States.[2] California has experienced several of the largest wildfires in State history in the past several years, with significant increases in high severity fire, resulting in hundreds of millions of dollars of annual firefighting costs and significant property and environmental damage.
- The 2006 heat wave in the San Joaquin Valley contributed to a large increase in hospitalizations and deaths. Researchers estimate that the total health costs of that event were greater than $5.5 million ($2008).[3]

These costs will continue to grow. By taking proactive steps now and integrating the impacts of a changing climate, California can minimize future disruption by enabling communities, infrastructure, and natural systems to withstand, respond, and adjust to changing average conditions and extreme events.

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1. https://www.ucdavis.edu/news/drought-costs-california-agriculture-184b-and-10100-jobs-2015

2. Abatzoglou, JT and AP Williams. 2016. Impact of anthropogenic climate change on wildfire across western US forests. *Proceedings of the National Academy of Sciences* 113(42): 11770-11775.

3. Knowlton, K, M Rotkin-Ellman, L Geballe, W Max, and GM Solomon. 2011. Six Climate Change-Related Events In the United States Accounted for About $14 Billion in Lives Lost and Health Costs. *Health Affairs* 30(11): 2167-2176.

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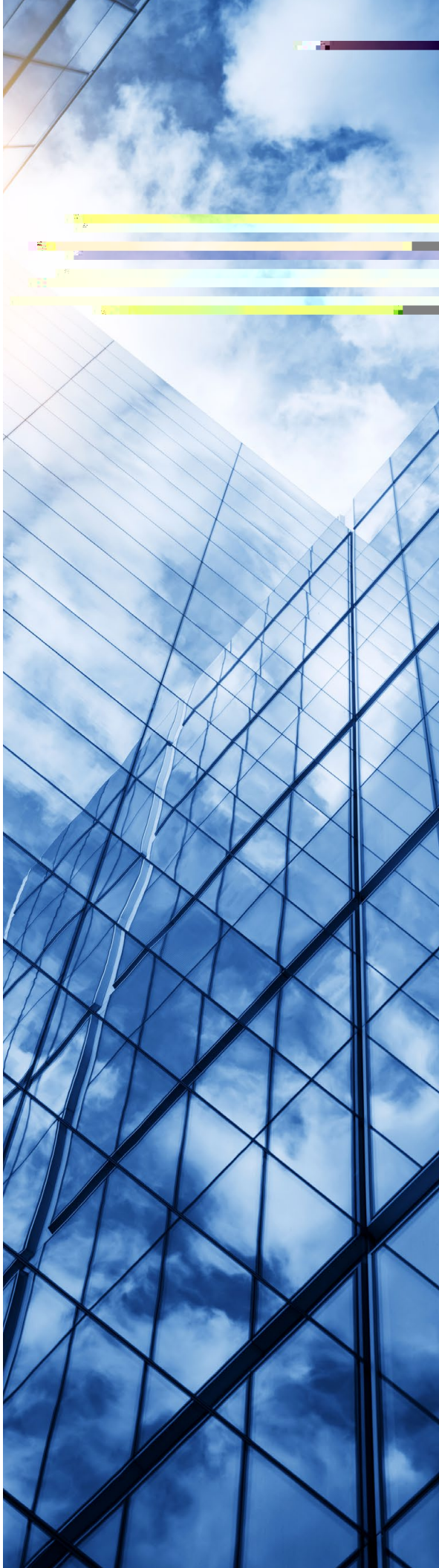
Introduction

Executive Order (EO) B-30-15 (April 2015; Appendix A) identified three actions to advance adaptation and resilience:

1. Preparation of Implementation Action Plans to identify the steps that will be taken to realize the goals in *Safeguarding California*;
2. Direction to all State agencies to consider climate change in all planning and investment, including infrastructure investment; and
3. Direction to the Governor's Office of Planning and Research (OPR) to establish a Technical Advisory Group (TAG) to provide state agencies with guidance on how to integrate climate change into planning and investment.

This document is the product of the Technical Advisory Group (TAG) formed under EO B-30-15. The TAG was comprised of representatives from a majority of agencies, departments, offices and commissions of the Governor's executive branch, and members of the public, including local and regional governments, non-governmental organizations, and the private sector (see Appendix B). The TAG worked to create the framework of this guidance document, while a set of working groups were tasked with developing guidance on specific principles identified in the Executive Order. These include: local and regional coordination, infrastructure (both natural and built), equity and vulnerable populations, metrics, and climate scenarios. This document is the result of a series of meetings and reviews held between TAG members between April 2016 and January 2017.



Developing a Process for State Agencies

This guidance document is designed to inform planning and investment processes to address the two primary elements of resilience – planning for future conditions and doing planning itself differently. This document introduces a four step process and a set of resilient decision making principles for state agencies.

STEP 1 **IDENTIFY HOW CLIMATE CHANGE COULD AFFECT A PROJECT OR PLAN**

STEP 2 **CONDUCT AN ANALYSIS OF CLIMATE RISKS**

STEP 3 **MAKE A CLIMATE-INFORMED DECISION**

STEP 4 **TRACK AND MONITOR PROGRESS**

Building resilience requires not just integrating the changing climate in planning and investment, but also adjusting how we plan and invest to be flexible in the face of an uncertain and changing future and to explicitly consider principles of building resilience. A set of resilient decision making principles informs Step 3 of the process. These principles are specifically identified in Executive Order B-30-15 and Safeguarding California, and draw from a broad body of applied research on adaptation and resilience:

- Prioritize actions that promote integrated climate action
- Prioritize actions that promote equity and foster community resilience
- Coordinate with local and regional agencies
- Prioritize actions that utilize natural and green infrastructure solutions and enhance and protect natural resources
- Base all planning and investment decisions on the best-available science.

These principles should be used to guide climate-informed planning and investment decisions.

This guidance is intended to be integrated into all planning and investment, but it does not require creating an entirely new process. The steps that are outlined in this document can (and should) be integrated into standard practices, which can streamline their application and reduce the need for additional analysis. These processes include:

- Infrastructure design and feasibility studies,
- Permitting processes,
- Economic analysis, and
- Environmental review processes under the California Environmental Quality Act (CEQA) or the National Environmental Protection Act (NEPA)

Finding the Right Starting Point

The path to incorporating climate change will look different for each agency, depending on its unique mission and functions, as well as technical capacity and resources. This guidance is intended to assist agencies at whatever stage they are in. For those who are just starting to think about climate change, the document will provide an introduction to the risks and how to start considering them in planning and investment. For those who are more advanced, this document provides some common analytical practices.

Safeguarding California

This document is a component of State policy to prepare for and build resilience in the face of a changing climate. This policy is guided by the State's Climate Adaptation Strategy, *Safeguarding California*. California developed the first state-level, multi-sector climate adaptation strategy in 2009. Since then, the State has continued to develop and update this plan, which was renamed *Safeguarding California* in the 2014 update. This plan is updated every three years by the California Natural Resources Agency (Public Resource Code Sect. 71153).

Implementing this Guidance

This document provides a framework and starting point for State agencies to integrate climate change into planning and investment. It is intended to be flexible and adaptable as agencies gain more experience and data, tools, and as knowledge evolves in the future.

Who Will Use This Guidance

This document is designed to support State agency planning and investment. To that end, it should be employed by a range of State staff, including, but not limited to:

- Strategic planning staff
- Fiscal and budget staff
- Program managers
- Project designers.

Building a Resilient California

California is experiencing more frequent and severe extreme events, including storms and wildfires. Species are moving northward and upslope to find suitable places to live. The State's historic drought led to critically low reservoir levels, massive tree mortality, and the depletion of groundwater reservoirs. In 2016, the drought was estimated to have cost over $600 million, and the loss of almost 5000 jobs.[4] More change will occur over the coming decades, including increases in temperatures and rising sea levels. Shifting average conditions will be punctuated by more frequent and severe extreme events, including drought, wildfire, and storms. Together, these changes pose risks to California's people, natural resources, and infrastructure.

California is taking steps to minimize the size of these changes by reducing greenhouse gas (GHG) emissions, both in California and in partnership with other states and countries. However, even with the most successful efforts to reduce GHG emissions, some amount of change is inevitable. State agencies have an important role to play in building a Resilient California by ensuring that California's plans and investments are made in a way that will endure and thrive in changing climate conditions.

4. Azuara-Medellin, J; D MacEwan; RE Howitt; DA Sumner; and J. Lund. 2016. Economic Analysis of the 2016 Drought on Agriculture. UC Davis, Center for Watershed Science.

What is a Resilient California?

Climate resilience and adaptation are often discussed together, but it is helpful to distinguish between them. Generally, adaptation is an action or set of actions, and resilience describes a desired outcome.

California is taking steps to prepare for the impacts of a changing climate at the state, regional, and local level. Preparing for these changes is called *adaptation*. A series of adaptive steps contribute to resilience.

In a resilient California:

- Built infrastructure systems can withstand changing conditions and shocks, including changes in climate conditions, while continuing to provide critical services;
- People and communities can respond to changing average conditions, shocks, and stresses in a manner that minimizes risks to public health, safety, and economic disruption; and maximizes equity and protection of the most vulnerable so that they do not simply survive climate-related events, but thrive despite and after these events; and
- Natural systems can adjust and maintain functioning ecosystems in the face of change.

Resilient communities and systems continually learn and adjust in the face of change and disruption.

Building Resilience

Preparing for a changing climate requires accounting for different future conditions. However, building resilience is not just about planning for a different future. Planning itself must change. To that end, building resilience has two important components:

Planning for a different and changing future

All planning and investment needs to reflect changing climate conditions, changing average conditions and increases in the frequency and severity of extreme events.

*Adaptation is an adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.**

*Resilience is the capacity of any entity – an individual, a community, an organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience.***

* Glossary of Climate Change Terms. Office of Air and Radiation/Office of Atmospheric Programs/Climate Change Division. September 9, 2013 " https://www.epa.gov/climatechange

** Italicized text is a direct quote from: Rod in, Judith. 2014. The Resilience Dividend: Being Strong in a World Where Things Go Wrong. Philadelphia: Perseus Books Group (pages 3-4).

Integrating climate change into planning and investment is one key step toward building resilience, and will result in several benefits to State agencies, including:

- Enhancing the success and cost effectiveness of state projects. Consideration of climate change is fiscally prudent and should become part of standard business practice.
- Better planning practices, including awareness of long-term risks to projects or plans and the ability to account for those in the most economical manner;
- Reduced "surprises" that affect the performance of a plan or investment;
- Capture of multiple benefits and partners' contributions through approaching plans and investments in a more systemic manner.

Making planning, operationalization, and implementation decisions differently

Changing conditions require flexible and adaptive approaches to planning and investment. Building resilience in the face of change requires that planning and investment not only reflect resilience in their goals, but also in how plans and investments affect people, communities, economic conditions, and natural systems – all of which work together to build resilience.

Resilient planning begins with integrating changing climate conditions in design, operation, and maintenance of plans and investments, but also includes:

- Approaching decisions in a systemic manner, in order to account for interactions across sectors and scales;
- Accounting for environmental, economic, and community dimensions of decisions and decision outcomes; and
- Building adaptability and flexibility into implementation plans to adjust in the face of new information and changing conditions.

Scientific Foundation

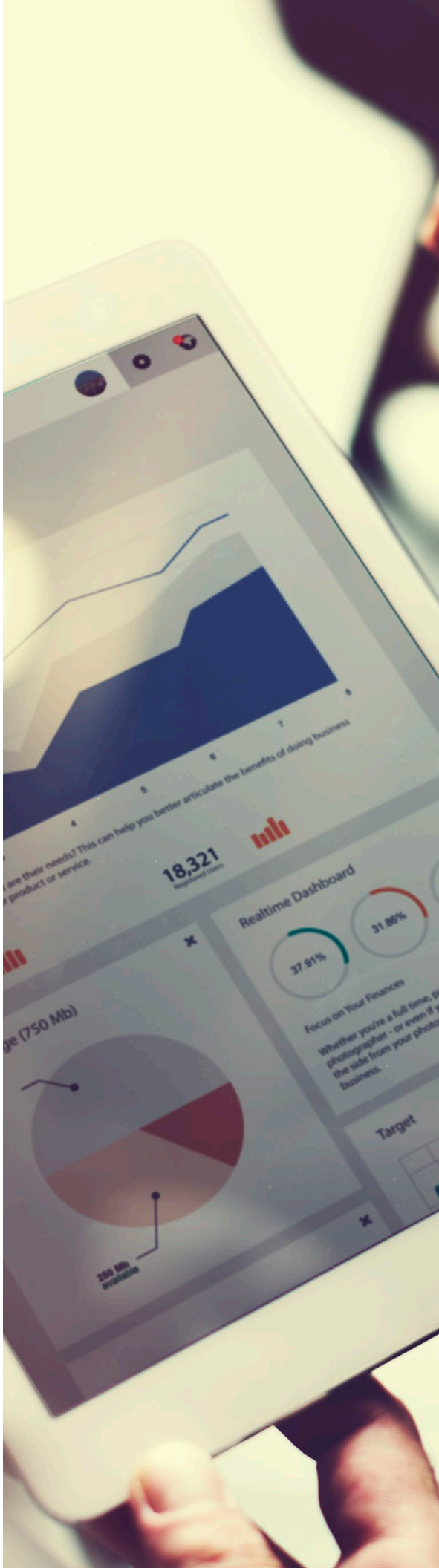
The State's Changing Climate

California's climate is changing with more substantial change on the way. The pace and severity of this change will depend on several factors, including – most importantly – the pace and scale of global greenhouse gas (GHG) emission reductions over this century.

Observed Changes

California is already experiencing the impacts of climate change. The Office of Environmental Health Hazard Assessment (OEHHA) prepares a regular report tracking indicators of climate change in California.[5] This report documents the many changes that are already underway, including:

- Recorded increase in annual average temperatures, as well as increases in minimum and maximum temperatures,
- An increase in the occurrence of extreme events, including wildfire and heat waves,
- Reduction in spring runoff volumes as a result of declining snowpack,
- A decrease in winter chill hours, necessary for the production of high-value fruit and nut crops, and



5. Office of Environmental Health Hazard Assessment, Indicators of Climate Change in California. August 2013. http://oehha.ca.gov/climate-change/document/indicators-climate-change-california

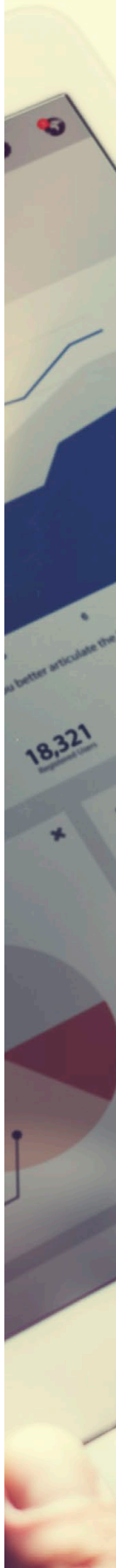
» Changes in the timing and location of species sitings, including migration upslope of flora and fauna, and earlier appearance of certain species during the year.

In addition to these trends documented over decades, the State's current conditions point to a changing climate. California has experienced four years of historic drought that has harmed human health and well-being.[6] Recent scientific studies show that such extreme drought conditions are more likely to occur under a changing climate.[7,8] And, in 2015, alone, California experienced nearly twice the acreage burned through wildfire as the five-year running average. These increases in the frequency and extent of wildfires in the Western United States have been attributed, in part, to a changing climate.[9]

Projected Changes

To plan for and estimate future climate impacts, scientists create model-derived climate projections by running global climate models (GCMs) with different emissions scenarios, also called Representative Concentration Pathways (RCPs). While emissions scenarios represent alternative images of how the future may unfold, global climate models project how the environment will respond to each scenario.

California has invested in a series of Climate Change Assessments to understand how a changing climate will affect the State. The Third Climate Assessment was completed in 2012, and the Fourth Climate Change Assessment will be completed in 2018. In each assessment, the State produces a set of climate projections at a scale that is more relevant for planning. Looking over several emission scenarios and using



6. California Department of Public Health, Mariposa County Health Department, Tulare County Health Department. Community Assessment for Public Health Emergency Response (CASPER) addressing the California drought – Mariposa and Tulare Counties. November 2015.

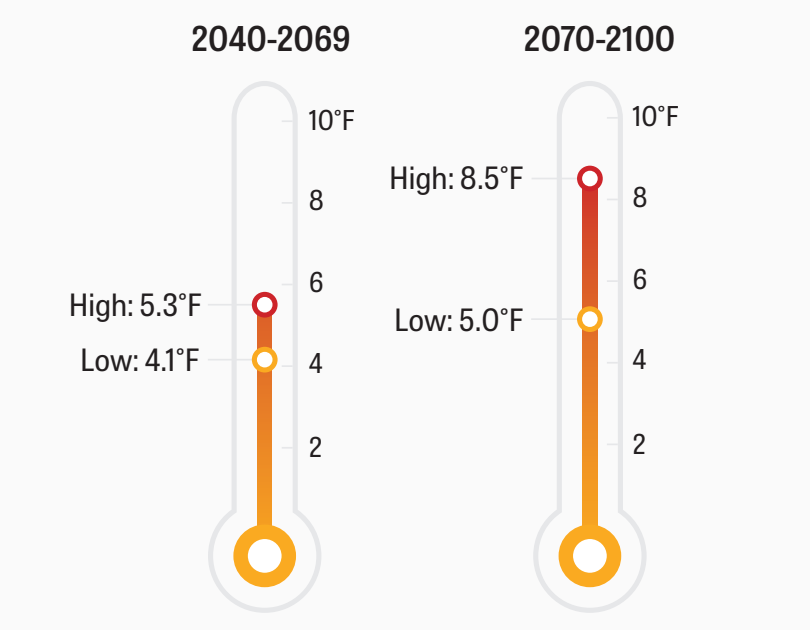
7. Diffenbaugh, N., D.L. Swain, and D. Touma. 2015. Anthropogenic Warming has Increased Drought Risk in California. *Proceedings of the National Academy of Sciences* 112(13): 3931-3936.

8. Cayan, D, T. Das, D.W. Pierce, T.P. Barnett, M. Tyree, and A. Gershunov. 2010. Future Dryness in the Southwest US and Hydrology of the Early 21st Century Drought. Proceedings of the National Academy of Sciences 107(50): 21272-21276.

9. Abatzoglou, John T. and A. Park Williams. 2016. Impact of Anthropogenic Climate Change on Wildfire Across Western US Forests. *Proceedings of the National Academy of Sciences* 113(42): 11770-11775.

a suite of global climate models, the analysis for the Fourth Assessment projects that annual average temperatures will increase between 4.1 and 5.3 degrees Fahrenheit by the middle of this century, and between 5.0 and 8.5 degrees Fahrenheit by the end of the century. Uncertainty in these estimates arises from several sources, including the path that global emissions take over the coming century, and the sensitivity of the atmosphere to future and past GHG emissions. The most current selection of GCMs and emission scenarios used in the fourth assessment can be found in Cal-Adapt, an online tool that presents data in a spatial format and makes it available for download.

Figure 1: Projected Average Temperatures in California



California is expected to experience dramatically warmer temperatures during this century. The figure shows projected increases in statewide annual temperatures for two periods

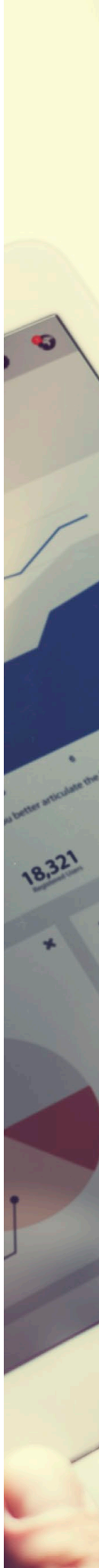
The projections show very little difference in the temperature change projected under different emission scenarios in the first half of the century. The similarity exists because of the long-lived nature of most GHGs, and the fact that their impacts on the environment are felt for many decades after they are emitted. Because of this, some amount of climate change is unavoidable due to the emissions already in the atmosphere, and early GHG emission reductions are critical for avoiding the worst impacts in the future.

These increases in temperature will be accompanied by rising sea levels and declines in mountain snowpack. The State will continue to see similar temporal patterns in precipitation, but with more falling as rain than as snow. California will also continue to see an increase in the frequency and severity of extreme events.[10] These projections of climate impacts are currently being updated for the Fourth Climate Assessment, using more up-to-date global climate models and global emission scenarios.

Together, the indicators and assessments provide a picture of California's changing climate, and convey two important messages:

» Change is already being experienced and is affecting people directly, as well as the infrastructure and the natural resources upon which they all depend today. Several of these changes have been directly linked to changing climatic conditions.

» Even with the uncertainty in future climate conditions, all future climate scenarios estimate some degree of change in future conditions.



10. Mastrandrea, M., C. Tebaldi, C.P. Snyder, and S.H. Schneider. 2009. Current and Future Impacts of Extreme Events in California. Prepared for the California Energy Commission. Available here: http://www.energy.ca.gov/2009publications/CEC-500-2009-026/CEC-500-2009-026-F.PDF

Building Resilience
A Process for State Agencies

EO B-30-15 directs State agencies to consider climate change in all planning and investment decisions. Within the context of this guidance, "planning" encompasses plans for tangible activities like physical construction and capital outlay, as well as and less tangible ones like those for program operations, grant administration, or community outreach. In the same vein, "investment" not only refers to the direct financial investments State agencies make in their own programs, operations, contracting, procurement, or capital outlay, but also the dollars given to local agencies to help achieve an agency's mission through grant making, technical assistance, and other local investments. This guidance applies to direct spending (e.g., construction of State-owned facilities, roads, and buildings), as well as money distributed to local agencies through grants and loans.

State agency functions that are considered planning activities and/or investments can include: Infrastructure and capital outlay projects, grants, permitting, purchasing, guidance development, strategic planning, regulatory activity, outreach, and education.

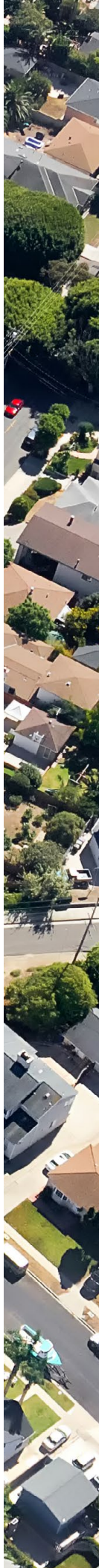
Defining Infrastructure

For purposes of this document, the following definition of infrastructure should be employed.

> *Assets that support the functioning of society or whose operation and maintenance are necessary for the public's health, safety, and welfare. These assets can be natural or man-made, as well as physical or virtual, and can be held publicly or privately. The benefits from these assets are generally available to a large portion of the population, because they are held in public trust, or because their adoption is so widespread that social processes have become reliant on them.*
>
> *Examples of California's critical infrastructure includes, but are not limited to: public and privately owned roads, bridges, ports, airports, and railways; water, wastewater, drainage, and sewer systems; schools; jails; hospitals and health care facilities; government facilities and commercial buildings; power plants; terrestrial, satellite, and wireless transmission systems; telecommunications and data information systems.*

This definition should be employed for the purposes of implementing this guidance to ensure that climate change is integrated into all infrastructure investment, not just those that are owned by the State. However, given the diversity in agencies' functions, there is no single way to undertake this task of integrating climate change, or a single future that all agencies should plan around. While some common considerations are identified in this process, it is important to note the following:

- Agencies need to determine the best approach to integrate climate change, given their mission and goals,
- Approaches will vary in their treatment of uncertainty, time scales, and complexity, depending on the specifics of a given analysis, and
- Approaches will differ when applied to specific projects (e.g., an infrastructure investment) versus a more systemic analysis (e.g., a strategic plan).



A Process for State Agencies

This four-step process is designed to guide agencies through a risk management process to determine how to integrate climate considerations into planning or investment decisions. These four steps are outlined in the following figure:

STEP 1

IDENTIFY HOW CLIMATE CHANGE COULD AFFECT A PROJECT OR PLAN

- Identify impacts of concern
- Assess the scale, scope, and context of climate disruption

STEP 2

CONDUCT AN ANALYSIS OF CLIMATE RISKS

- Select climate change scenarios for analysis
- Select an analytical approach

STEP 3

MAKE A CLIMATE-INFORMED DECISION

- Evaluate alternatives or design
- Apply resilient decision principles

STEP 4

TRACK AND MONITOR PROGRESS

- Evaluate metrics to track progress
- Adjust as needed

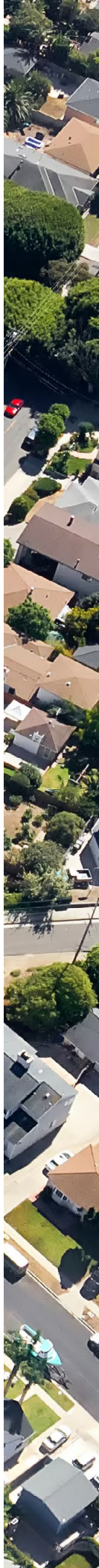
STEP 1 Identify How Climate Change Could Affect a Project or Plan

California's climate is changing, including changes in average conditions (e.g., increasing annual average temperatures) and increases in the frequency and severity of extreme events (e.g., winter rain storms). These changes affect how plans or projects perform today and in the future.

Identify Climate Risks of Concern

As a first step, all agencies should consider how climate change could affect a given project or plan over its expected, functional lifetime.

In considering potential climate risks to a project or plan, agencies should identify what factors of a given project have the potential to be affected by climate conditions. These factors are *Climate-Sensitive*



Planning Parameters. Throughout the planning and investment process, these factors should reflect the effects of changing climate conditions. In addition, these factors should be integrated into tracking the performance of a project or plan. Some parameters to identify are:

Lifetime

If the expected lifetime of a project is less than five years, it may not be necessary to integrate longer-term climate change into the design and analysis. However, even in these cases, agencies should consider the impacts of extreme events and ensure that planning and investment decisions reflect current climate conditions. **Given recent changes, relying on historical data can result in inadequate design, even without accounting for future change.**

Location

Where will the project be located or the plan focused?

Climate Impacts

What changing climate conditions could affect this project or plan? Consideration should include the following:

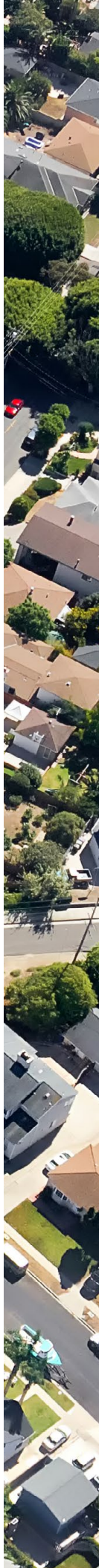
- Sea level rise – both increasing in average levels and increasing flood levels under extreme events including storms and King Tides.
- Flood, storm water runoff, landslides
- Drought, subsidence
- Wildfire, forest health decline/emergency
- Extreme heat, heat island effects (urban and ex-urban)
- Extreme weather (storms, wind, snow, dry lightning, etc)
- Natural resource degradation
- Human health and well-being, including displacement of communities and individuals.

To visualize the potential risks of these impacts, agencies should map the location of investment or planning areas, and overlay that map with climate risk data from Cal-Adapt. If available, sea level rise and storm surge data can be accessed from Coastal Storm Modeling System (CoSMoS). Using these data, identify what climate impacts are likely to affect a plan or investment. For an overall picture of changes that have been observed and their impacts, the Indicators of Climate Change in California is an excellent resource.

Key Terms for Step 1

Climate impacts: *Climate change is affecting average conditions as well as the occurrence and severity of extreme events. In thinking about climate change, agencies should consider both changes in average conditions (e.g., rising daily maximum temperature or higher mean sea level), as well the effect of an increase in the frequency and severity of extreme events (e.g., wildfire or heat waves). The latter will include extreme heat, drought, and higher storm surges that accompany higher mean sea levels.*

Functional lifetime: *In answering these questions, consider the functional lifetime of a project. The functional lifetime of a project or plan is the time that it is expected to be in use. This may be different from the financing terms. For instance, a building may be financed for thirty years, but it will be occupied well beyond that timeframe.*



Characterize Climate Risk

There are many different ways to approach integrating climate change into planning and investment. Determining an analytical approach should be informed by the characteristics of the risks. The questions below are deigned to assess four dimensions that characterize risks from climate change:

Scale and Scope of Risk

Consider the criticality or consequence of disruption to understand the scale and scope of the risk posed by changing climate conditions and extreme events.

Vulnerability and Adaptive Capacity

Identify who and what is affected by climate-related disruptions to determine the vulnerability and adaptive capacity of the people, places and resources affected.

The Nature of the Risk

Consider how a climate-related disruption will affect the ability of people, places and resources affected to adapt, learn, and prepare for future conditions.

Economic Impacts

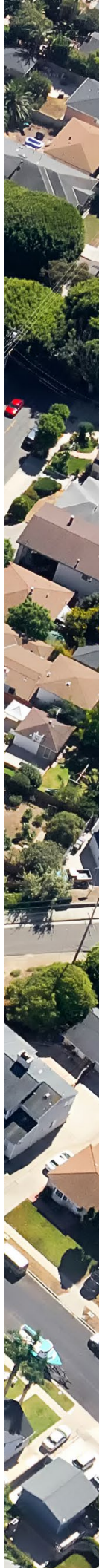
Consider the cost associated with climate disruption – this can include physical damage, service disruption, repair costs, or costs for the surrounding community or natural resources.

These questions are not intended to be sequential, but are designed to help provide context on the severity that climate-related impacts will have on a project or plan, community, or natural systems. Answers to the questions can help to guide State agencies in selecting future climate scenarios for consideration and the analysis approach to employ, both of which are discussed in Step 2.

In answering these questions, agencies are taking the first step to integrating climate change into planning and investment. In some cases, the answers to these questions will lead an agency or department to undertake a much more robust analysis of climate change. In others, the answers may lead to the decision not to further consider climate change. This diversity is to be expected.

If the expected useful lifetime of a project is **less than five years**, then it may not be necessary to integrate longer-term climate change into the design and analysis. However, even in these cases, agencies need to

- Account for the impacts of extreme events, even over a short lifetime, and
- Ensure that planning and investment decisions reflect current climate conditions. **Given changes in recent decades, relying on historical data can result in inadequate design, even without accounting for future change.**



QUESTION #1

1

How severe are the consequences if your project or plan is disrupted by an extreme event or by changes in average conditions?

This question can be answered in a number of ways, including using tools such as Cal-Adapt or going through a simple thought-exercise. However, this is also a common output of regularly required environmental impact reports and environmental impact statements as required by CEQA and NEPA. These outputs can be used in considering the consequences of a plan or project.

LOW IMPACT
Minimum disruption, limited scale and scope

MODERATE IMPACT
Inconvenience, but limited in scope and scale

HIGH IMPACT
Unacceptable risk and/or extensive scale and scope

QUESTION #2

1

Who or what will be affected by disruption of the project or plan?

Using tools available to investigate the population and resources in the geographic area of a given population or plan, consider who or what will be affected by project or plan disruption. Consider both near- and long-term impacts.

To identify population characteristics, employ CalEnviroScreen, the Healthy Places Index, or the Regional Opportunity Index, as described in Principle 2: Prioritize actions that promote equity and foster community resilience.

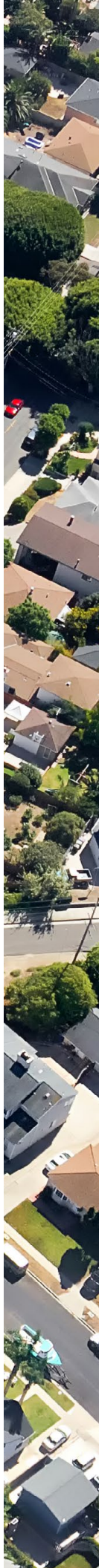
The following resources can be used to identify critical natural systems:

» FRAP Assessment (http://frap.fire.ca.gov/)
» The CDFW Vegetation Classification and Mapping Program: https://www.wildlife.ca.gov/Data/VegCAMP
» The CDFW Natural Diversity Data Base: https://www.wildlife.ca.gov/Data/CNDDB
» Consultation with the California Department of Fish and Wildlife and/or regional conservation plans and priorities.

ADAPTABLE
Low impact on communities, infrastructure, or natural systems

MODERATELY ADAPTABLE
Communities, systems, or infrastructure readily able to adapt or respond to change

VULNERABLE
Vulnerable populations
Critical infrastructure
Critical natural systems
Areas of economic, historic, or cultural significance



QUESTION #3

1

What is the nature of this disruption?

In considering the project or plan, think about what the nature of a climate disruption will be. While this can be difficult to discern, it is important to think about the near- and long-term effects of the disruption – is it permanent or temporary? How will the disruption affect the ability to undertake flexible approaches and respond to uncertain and changing conditions? For example, a disruption could have minimal effect on existing communities, infrastructure, or natural systems, but will eliminate the ability for the affected area to provide space for development in the future. In this case, the disruption is limiting options for future actions or adjustments.

TEMPORARY
Future flexibility maintained
People or systems readily able to respond or adapt

LIMITING
Limits future flexibility

PERMANENT
Irreversible
Threat to public health and safety

QUESTION #4

1

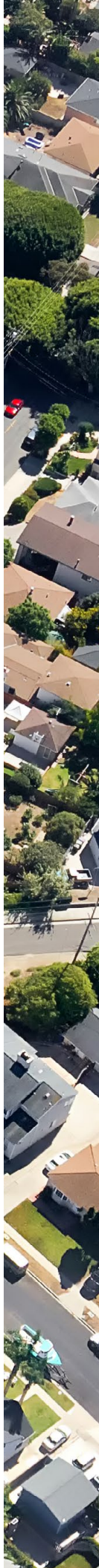
What are the economic implications of climate disruption?

Finally, consider what the economic impacts will be as a result of climate disruption. Economic considerations should include market and non-market costs. Cost considerations should include physical damage, repair costs, costs associated with displacement or relocation, and service disruptions. In addition, agencies should consider costs resulting from mental and physical health impacts and damages to natural resources.

LOW
Response and disruption costs are low

MEDIUM
Cost of disruption and/or cost of response could be large

HIGH
Costs of disruption and/or response will be unacceptably high



STEP 2 Conduct an Analysis of Climate Risk

The preceding series of questions is constructed around four dimensions of climate risk. The answers to these questions can be used to guide the selection of analytical approaches and climate scenarios for consideration.

Analytical approaches can range from the very simple to highly complex. More complex approaches to analyzing climate risk are likely to have the following characteristics:

- Use of a larger number of global climate models,
- Use of a number of emission scenarios to characterize a broad range of potential climate futures, and
- A comprehensive assessment of uncertainty, including sensitivity analyses or stress testing.

On the other hand, simpler approaches will use fewer climate models and a more straightforward use of climate parameters. A simpler approach may not include an uncertainty analysis.

Figure 2 matches the answers from the questions from Step 1 with characteristics of analytical approaches and climate scenarios. For example, consider a plan or project to construct a new visitor center at a coastal park. Because of the location and functional goals of the project, the answers to the all questions may fall into far left column of the figure. In this case, consideration of climate can be approached in a simple manner and using low GHG emission scenarios (Representative Concentration Pathway (RCP) 2.6 or 4.5) for considering climate change impacts for the latter half of the century.

Another example is the construction of a wastewater treatment facility. In this case, the answers to the questions lie at the other end of the range, toward the far right side of the figure. Disruption of this facility will affect a large population and could result in severe environmental impacts. In this case, robust methods should be used to analyze climate impacts and a high emission scenario (RCP 8.5) employed to consider climate impacts in the latter part of this century. Recognizing the high degree of complexity in using these data, several examples are included later in this document to illustrate approaches that can be employed by State agencies when integrating climate change data.

A Note for Considering Future Climate Scenarios

For all analysis considering impacts before 2050, agencies should employ a high emission scenario (RCP 8.5). This is because there is little different between the emissions scenarios for impacts projected in the first part of the century and current emission trends are following RCP 8.5. For all analyses considering impacts after 2060, the risk management approach should guide the selection of emission scenario.

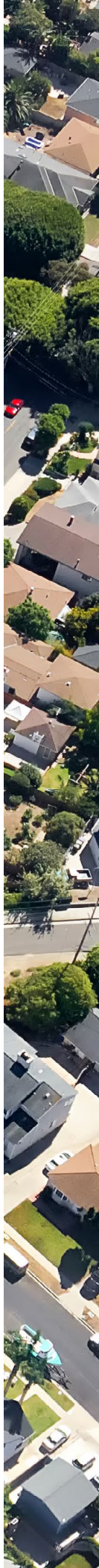
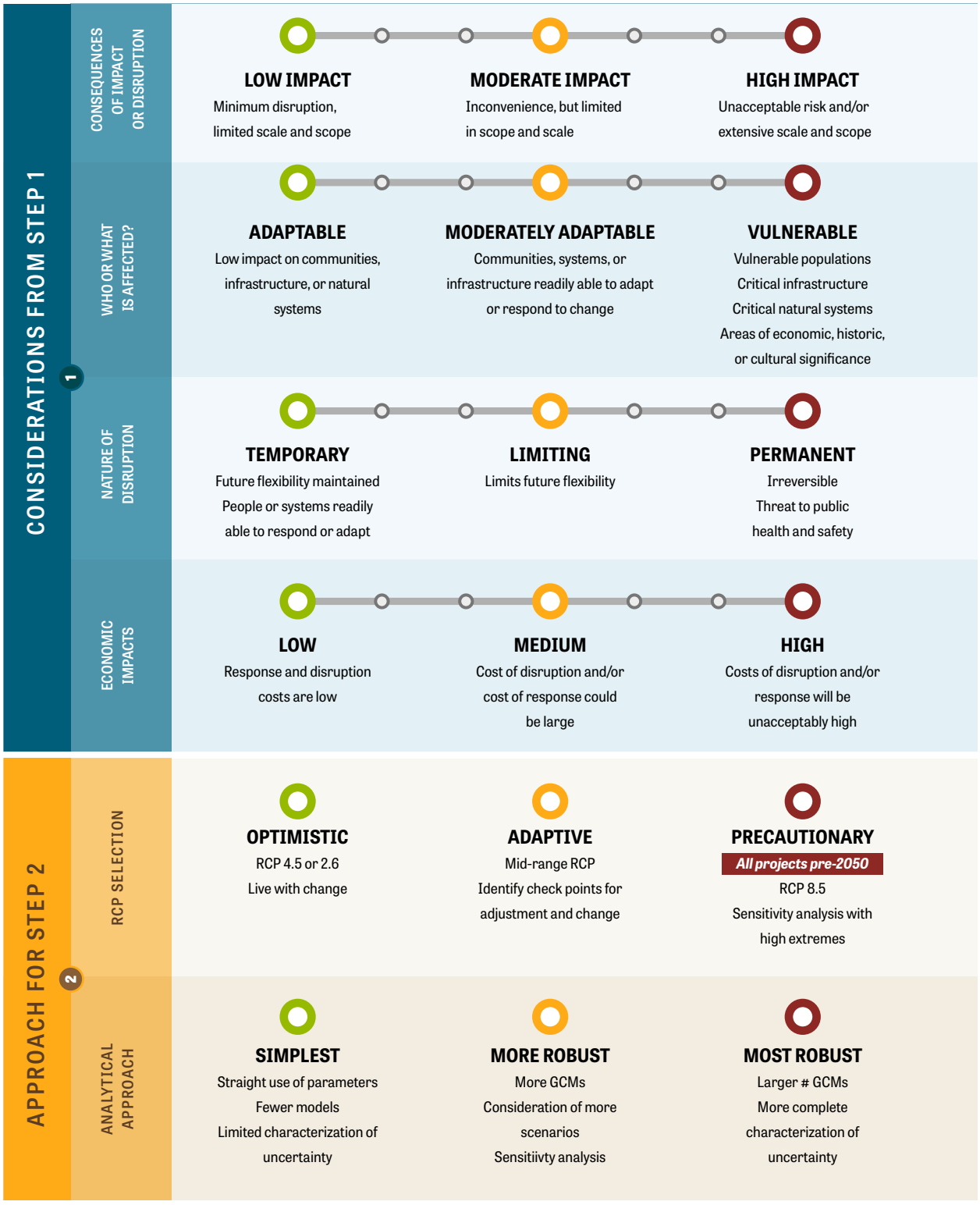


Figure 2: Mapping Risk Characteristics to Analytical Approaches to Integrate Climate Change



Common Considerations for Analyzing Climate Change

Regardless of the approach taken, State agencies should adhere to the following common guidelines, to the extent feasible:

Magnitude of Risk

When considering what magnitude of climate risk to integrate into a plan or project, agencies should follow these guidelines

- When considering climate change for 2050 or sooner agencies should use RCP 8.5 (business as usual)
- For impacts being estimated after 2050, agencies should follow the risk management approach to select scenarios for analysis.

Use Recent Information

All State agencies should use the most recent information on climate change available, as well as projected impacts developed through the California Climate Change Assessment.

California has invested significant resources in developing climate change information for the entire state at a resolution that is useful for planning at both a statewide and regional scale. These data are called *downscaled climate data*. Downscaling is an analytical tool that starts with data from global climate models and then makes adjustments using statistical techniques and/or numerical models to provide projections of climate impacts at a finer scale. California has developed a set of downscaled climate data for the State using the Localized Constructed Analogs, or LOCA, statistical downscaling technique. All data are available through Cal-Adapt, an online tool that displays climate impacts in a spatial format, and makes the underlying data available for download.

Work with Regionally Downscaled Data

State agencies should work with regionally downscaled data from at least two of the four global climate models (GCMs) that have been prioritized for California's Fourth Climate Change Assessment.

To ensure consistency in planning for climate impacts, State agencies are directed to use the latest climate change information. Cal-Adapt is the most updated source of climate change data. Of the 32 internationally recognized coarse-resolution GCMs, the State of California has chosen

Projecting Climate Impacts in California

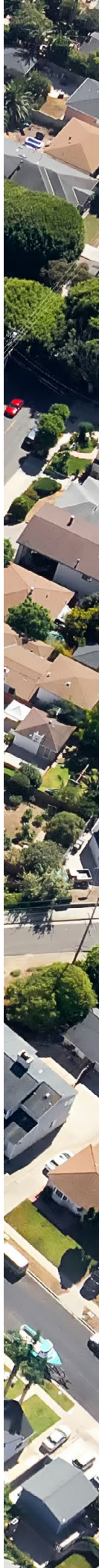
Climate projection data are available for 32 global climate models (GCM). Each GCM projects climate impacts on a global scale, at a coarser resolution. These models are run to model climate impacts under different global emission scenarios. These global emission scenarios are called *Representative Concentration Pathways (RCPs)*.

The State has taken results from these GCMs, and using a technique called LOCA (Localized Constructed Analogs), estimated impacts at finer scale. This process is called *downscaling*.

Downscaled climate data is availbable for 2 RCPs: one representing a high global emissions path (RCP 8.5) and one for a medium global emission path (RCP 4.5). For purposes of the State Climate Assessment, the Climate Action Team has selected the four GCMs to be used to inform the studies underway.

Through the Fourth Assessment, the State is also developing an extreme drought scenario that assumes that the 2012-2016 drought continues for the next 20 to 30 years.

Downscaled climate projections for California are available via Cal-Adapt for State agencies to use for analysis.



four models to utilize in its climate studies for the Fourth Assessment.[11] The following four GCMs have been prioritized by the State of California[12] for use in future climate studies:

1. HadGEM2-ES (warm/dry)
2. CNRM-CM5 (cool/wet)
3. CanESM2 (average)
4. MIROC5 (complement/covers range of outputs)

Consider Sea Level Rise

State agencies must consider sea level rise in the following situations:

» Any project or planning area that lies within the present-day coastal zone must address rising sea levels. This includes along open ocean, in harbors and bays, and in estuarine zones.

» Project designers should refer to Cal-Adapt or another sea level rise viewer to assess the impacts of rising sea levels under the ranges indicted by the Ocean Protection Council's Sea Level Rise Guidance for 2050 and 2100. If the project or planning area is affected by sea level at either future date, sea level rise must be accounted for in the plan or project.

If the plan or investment meets either of the preceding criteria, it must incorporate rising sea levels into design. Analysis and consideration of sea level rise should follow the same risk-based guidelines provided for other climate impacts.

Consider a worst-case scenario

Agencies do not need to design for a worst-case scenario. In fact, in some cases, it would be impossible to do so. However, under changing climate conditions, it is helpful to identify a worst-case scenario to inform planning and to have something to track changes alongside and adjust planning and investment accordingly.

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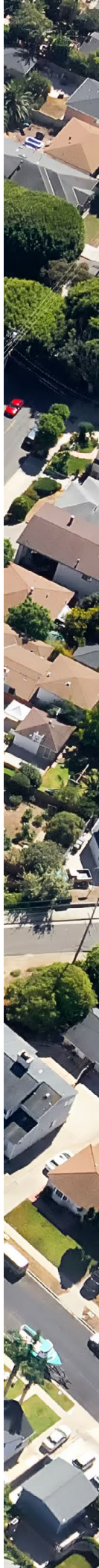
11. Pierce, D.W., D.R. Cayan, L. Dehann. June 2016. Creating Climate projections to support the 4th California Climate Assessment.

12. The Climate Action Team Research Working Group, as the steering committee for the Fourth Assessment, in consultation with Scripps Institution of Oceanography, Department of Water Resources, the California Energy Commission, the Governor's Office of Planning and Research, and California's Natural Resources Agency, reached consensus on prioritization of the four global climate models (GCMs) indicated above.



STEP 3 Make a Climate-Informed Decision

Once climate change has been integrated into planning and investment decisions, the resilient decision making principles can be employed to guide decisions.

Below are guidelines on how to build these principles into planning and investment decisions. Implementation of the principles should correlate with the outcomes of the risk management approach outlined above. For example, in the case of projects or plans that have larger consequences of disruption, affect vulnerable populations, and/or result in irreversible impacts, adherence to these principles should be scaled accordingly.

Principle 1: Prioritize integrated climate actions

California is committed to implementing an integrated approach to addressing climate change, which means that agencies will prioritize actions that support both the reduction of greenhouse gas emissions and adaptation to impacts, leading to increased resilience in the face of change.[13]

Integrated climate action has several benefits, including achieving broad benefits from investments, avoiding maladaptation or unintended consequences, and building a broader coalition of support for a plan or project. Integrated climate actions can also open the door to additional funding sources for projects. To operationalize integrated climate action, agencies must employ a systems approach to planning and investment decisions.

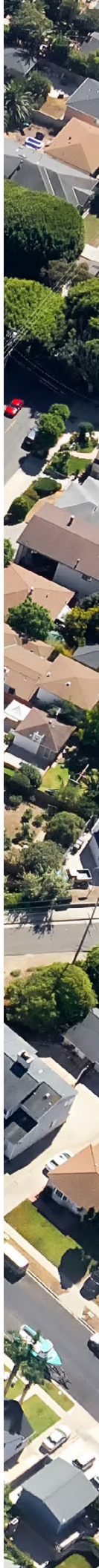
Identify and consider alternatives

Analyze and consider a range of alternatives for any infrastructure project with each alternative addressing the resilience and greenhouse gas emission reductions potential. Analysis should consider climate impacts throughout the intended lifespan of the project.

Consider impacts beyond the physical or temporal scope of the project or plan

Consider impacts beyond a project or plan footprint to identify and quantify, when possible, a full range of co-benefits and impacts, such as job creation, upstream and downstream impacts, community benefits and others not included in state or federal environmental review.

13. GHG emission reduction includes both reduction and avoiding direct emissions, as well as maintaining and increasing the storage and capture of carbon.



Identify and, when possible, quantify project or plan co-benefits

For all projects or plans, consider the co-benefits of each alternative including, but not limited to:

» Adaptation and resilience benefits, including consideration of maladaptation and future flexibility provided by a given alternative,
» GHG emission reductions, including changes in biological carbon from land management activities,
» Improvements in other environmental and public health conditions including air and water quality, habitat protection, and resource protection, and
» Benefits to vulnerable populations or individuals' health, living conditions, and well-being.

Consider all co-benefits in selecting project or plan alternatives

When choosing among alternatives, agencies need to evaluate the direct climate resilience and adaptation benefits. To the extent possible, co-benefits should also be considered.

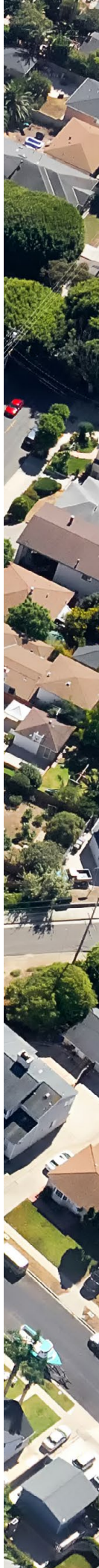
Principle 2: Prioritize actions that promote equity and foster community resilience

Building a resilient California requires increasing the capacity of communities and people to be able to withstand and recover from climate-related disruptions, and to be able to learn and adapt in the face of this change. Some communities and groups are in a better position to respond, recover, and adjust as these changes occur, while others are more vulnerable. In many cases, the most vulnerable are the same communities that already experience health inequities, or systemic differences in health status that are preventable and therefore unfair.[14, 15]

Factors that contribute to vulnerability of people and communities to the impacts of climate change include:

14. Shonkoff SB, Morello-Frosch R, Pastor M, Sadd J. The climate gap: environmental health and equity implications of climate change and mitigation policies in California – a review of the literature. 2011. *Climatic Change* 109(1):485-503.

15. Commission on Social Determinants of Health. Achieving Health Equity: From Root Causes to Fair Outcomes. Interim Statement. Geneva: WHO. 2007



» **Existing inequities, institutionalized racism, or exclusion:** People facing disadvantage or discrimination often have lower socioeconomic status, which result in fewer resources for preparing, coping and recovering from climate impacts. People facing inequities tend to have higher rates of illnesses associated with or exacerbated by climate change, such as asthma or cardiovascular disease. Similarly, people with disabilities are not inevitably more vulnerable to climate risks, but if their mobility, informational, health care and other needs are not taken into account in preparedness planning, they suffer higher rates of illness, injury and death in climate-related events.[16]

» **Poor environmental conditions, access to services, or living conditions**: Populations at higher risk under a changing climate include those who are uninsured or underinsured or lack access to health care, lack access to transportation, live in areas with poor air quality, live on upper floors of tall buildings, live in areas with lots of impervious surfaces and little tree cover, and lack life-supporting resources such as adequate housing, ways to cool living space, are food insecure or lack adequate medications, or are tenants or renters.

» **Physical states or conditions that increase vulnerability:** Older adults, young children, pregnant women, and people with chronic health conditions or mental illness are more susceptible to harm from effects of climate change.[17]

» **Lack of investment and opportunities:** The disinvestment and resource deprivation historically experienced by communities facing inequities leads to degraded living conditions and lack of power over decisions that affect their lives. A targeted and equity-focused approach to investment and resource allocation can reduce vulnerability to harm from climate change.

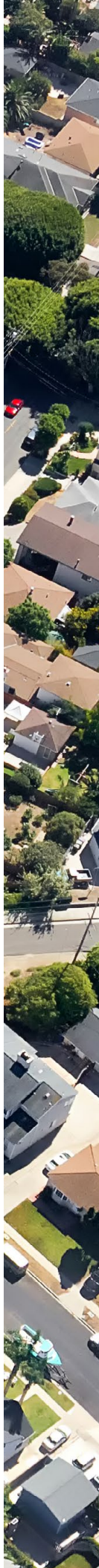
Vulnerable Populations

While not an exhaustive list, vulnerable populations can include the following groups:

- Low-income people
- Some communities of color
- People with disabilities
- Immigrants and refugees
- People who are linguistically isolated
- People who are physically or socially isolated
- People with existing health conditions, including chronic diseases and mental illness
- Young children
- Older adults
- Pregnant women
- People experiencing homelessness
- Indigenous people and tribal nations
- Lesbian, gay, bisexual, transgender, queer, and questioning (LGBTQQ) communities
- Outdoor workers and farmworkers
- Individuals who are or have been incarcerated

See a full list of descriptions of how each of these populations are more vulnerable to the impacts climate change than others:

opr.ca.gov/docs/20180312-Vulnerable_Communities_Descriptions.pdf



16. USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, DC, 312 pp. http://dx.doi.org/10.7930/J0R49NQX

17. Ibid.

Operationalizing this principle can employ the following steps:

Identify communities that experience the disadvantages described above

The first step in promoting equity for vulnerable communities in investment and infrastructure plans is to identify vulnerable communities that experience one or more disadvantages as described above, or by identifying a geographic area of disadvantage in which to invest resources. The tools in the sidebar can be used to identify vulnerable communities by census tract. The tool selected should be responsive to the particular infrastructure and help identify the particular climate exposures or vulnerabilities inherent in that infrastructure.

Because vulnerability or resilience to climate change impacts is determined strongly by wealth, opportunity, health, and living conditions, communities identified by any of the above tools as disadvantaged will also have higher risks of harm from climate change.

Engage to build collaborative relationships

After identifying vulnerable communities in need, state agencies can work with existing community-based organizations or agencies that organize those groups, to reach out and form collaborative relationships. Local health and human services departments can provide assistance in reaching such organizations. Inclusive public engagement brings about better decisions through increased input from different perspectives, increases buy-in and acceptance of decisions and support for their implementation, and is essential to give people a voice and decision-making power over actions that affect their lives.

Complete the Equity Checklist

For a planning or investment decision, State agencies should apply these equity considerations, with greater effort being applied in the case of the projects that have direct effects on communities or individuals. In doing so, agencies need to take into account specific stipulations and constraints of existing legislation, policies, and funding sources. Appendix C includes the Equity Checklist.

CalEnviroScreen 3.0:

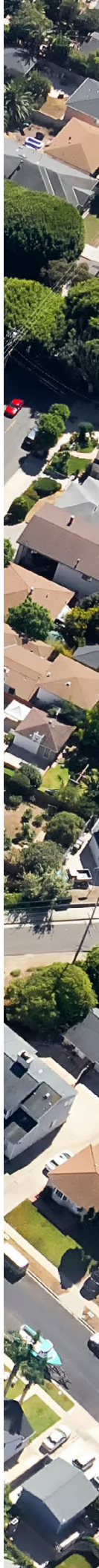
CalEnviroScreen 3.0 provides identification of disadvantage through pollution burden and population characteristics. oehha.ca.gov/calenviroscreen/report/calenviroscreen-version-20

Healthy Places Index:

The California Healthy Places Index (HPI) is an interactive online data and GIS mapping tool that allows users to easily visualize the social and economic conditions that shape health in each neighborhood in California. HPI is validated with life expectancy and provides census tract rankings across the state. As of 2017, the Healthy Places Index platform also includes climate change indicators. This tool provides graphic overlays of climate risks, vulnerabilities and indicators of adaptive capacity, along with the healthy places index score, and other key decision support layers. HPI moves data into action by providing policy briefs outlining best practices to address risks associated with climate indicators. healthyplacesindex.org

Regional Opportunity Index:

Another mapping tool to identify census tracts lacking in opportunities and needing investment is the Regional Opportunity Index (ROI) from the UC Davis Center for Regional Change. The goal of the ROI is to help target resources and policies toward people and places with the greatest need. The tool incorporates both a "people" component and a "place" component, integrating economic, infrastructure, environmental, and social indicators into a comprehensive assessment of the factors driving opportunity. interact.regionalchange.ucdavis.edu/roi/data.html



Principle 3: Coordinate with local and regional agencies

Local and regional agencies are critical partners in implementing on-the ground adaptation activities. Meaningful coordination with local and regional agencies will facilitate project and plan implementation. Various agencies of the State work with local and regional partners through a variety of formal and informal mechanisms. Cities and counties are the most familiar local partners in working with the State on policy initiatives but numerous other agencies are critical for the State to continue to make progress.

Depending on the project under consideration, many of these agencies could have a role to play in helping to build resilience. Given the diversity in how state agencies engage with local agencies, the following are best practices that state agencies should employ in designing programs to engage with local and regional agencies.

Look at policies and projects holistically.

Consider local and regional context and the ability of the policies and projects proposed to expand economic development, connectivity, innovation, community-led capacity and awareness of climate risks by the public and local decision makers. Promote regional collaboration between local, state and federal government, NGOs, local action collaboratives, environmental groups, and academics for climate adaptation options and implementation. State efforts should work in this regional context collaboratively to preserve resources, avoid duplication, and align with existing jurisdictional authority (MPOs, COGs, Water Districts, IRWMPs, AQMDs, etc.).

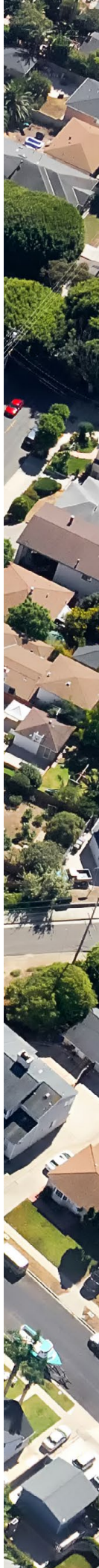
Seek out existing community-based organizations or agencies that organize vulnerable groups identified by Principle 2.

State agencies should seek out existing community-based organizations or agencies that organize those groups, to be able to reach out and form collaborative relationships. Relationships should not be ad-hoc, rather built over time at the agency level to support trusted working relationships that can be leveraged for individual policy, program and project development efforts.

Local and Regional Agencies

When considering local and regional agencies for coordination, it can be helpful to consider more than cities and counties. Other local and regional agencies include but are not limited to:

Air pollution control districts
Irrigation districts
Community service districts
Councils of Governments or Metropolitan Planning Organizations
Water and sewer districts
Local Agency Formation Commissions
Joint power authorities
Joint highway districts
Transportation or transit districts
School and community college districts
Recreation and park districts
Resource conservation districts
Special assessment districts
Vector control districts
Fire protection districts
Harbor and port districts



Establish or expand traditional and non-traditional partnerships
Work with local agencies to establish alliances and networks to accelerate effective and durable problem-solving (e.g., between/among public and private resource managers, scientists, decision-makers); share knowledge openly and actively; regularly engage the public on the science as well as solutions; and build capacity for local community action.

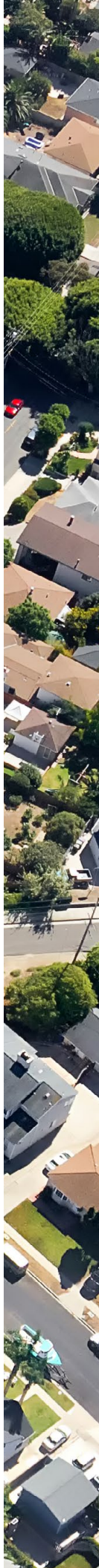
Acknowledge that in some cases the historical and cultural heritage transcends economic costs and benefits.
Historic sites, iconic plants and animals, natural resources that support livelihoods and ways of life and even the character of entire landscapes are some of the features of cultural heritage upon which many people depend and about which they care deeply. Work with local and regional partners to identify these sites and prioritize them in State agency actions even when they can't be fully quantified.

Principle 4: Prioritize actions that utilize natural and green infrastructure solutions and enhance and protect natural resources

The State's natural resources are an integral part of the State's climate programs. Healthy, well-maintained natural systems can provide significant climate mitigation benefits and can also provide resilience in the face of change. Natural infrastructure is the preservation and/or restoration of ecological systems, or utilization of engineered systems that use ecological processes, to increase resiliency to climate change and/or manage other environmental problems.

Natural Infrastructure may include, but is not limited to:

1. **Functioning natural systems** that deliver goods or services supplemental to built infrastructure. Examples of this type of natural infrastructure include ecologically intact and functioning forest and other watersheds, grasslands, shrub lands, riparian areas, shorelines and open ocean ecosystems like eelgrass beds.
2. **Natural/ecological processes** and features that are engineered to supplement traditional built infrastructure. Examples of this "hybrid" use of natural infrastructure include street trees and greenspace for water catchment, infiltration and surface cooling; water treatment facilities that utilize ecologically functioning wetlands; flood mitigation systems that utilize the natural floodplain and stable shorelines used in tandem with constructed flood barriers.



Executive Order B-30-15 directs state entities to give priority to natural and green infrastructure in its plans and investments. These investments will enhance the resilience of the state's natural resources and help maintain the quality of life in California.

Agencies should fully account for natural resources in planning and investment decisions. This includes considering how natural systems can enhance the resilience of a given project or plan and how projects and plans can be designed to enhance the resilience of natural systems. When comparing alternatives, agencies should choose the natural or green infrastructure alternative where effectiveness and cost are equivalent.

For infrastructure investment, agencies should evaluate whether natural or green infrastructure solutions are available to integrate into design. Guidance on identifying such options is provided below in the chapter on "Climate-Informed Infrastructure Investment."

Principle 5: Base all planning and investment decisions on the best-available science

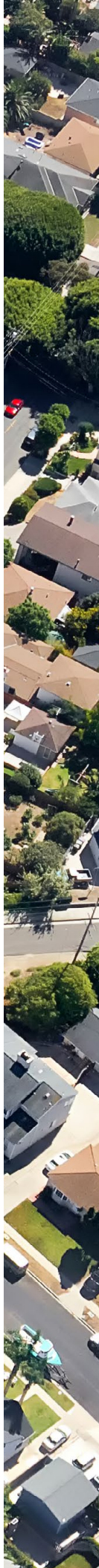
California has developed a robust body of data and knowledge on trends in climate change and projected climate impacts. These data should be used to inform all stages of planning and investment and to evaluate project and plan alternatives and future performance using data that reflects changing climate conditions. Furthermore, planning and investment decisions should reflect locally-produced climate change information and local knowledge, to the extent feasible. To the extent feasible, State agencies should adhere to the following guidelines:

Data selection

Evaluate project performance using planning parameters that reflect future changing climate conditions. Develop parameters using downscaled climate data (based on the LOCA methodology) from the State Climate Assessment. Where available and appropriate, State agencies can supplement the LOCA data with more locally- or regionally-specific data sources, or employ other tools that integrate changing climate conditions.

Employ visualization tools to understand projected climate impacts

Design projects to account for impacts outlined in this guidance and OPC Sea Level Rise Guidance.



Develop and report metrics to track progress

Identify key metrics to track progress and inform management and investment decisions. This should include tracking:

» The rate and impact of changing climate conditions
» The resilience of a project or plan under changing conditions.

STEP 4 Tracking and Monitoring Progress

Changing climate conditions necessitate an adaptive management approach. An adaptive management approach is informed by tracking changing climate conditions and the performance of a plan or project. Building check points into a project or plan timeline can help to create a system for regular review and, if needed, adjustments. Under changing climate conditions, this approach is often referred to as *adaptation pathways*.

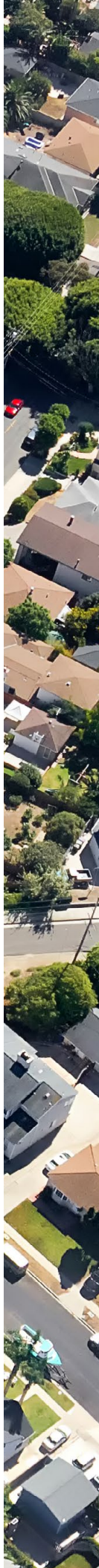
Developing Metrics to Track Progress

Developing a robust set of metrics to track progress and identifying points – either in process, design, or operation – where adjustments can be made is a key part of an adaptive management approach. Ongoing and inevitable climate impacts require changing processes that have been static. State agencies need to develop metrics, report regularly on changing conditions and state performance, and incorporate lessons learned for more effective interventions.

Metrics should be developed from the outset of the project or plan, and should capture the performance outcomes, changing climate conditions, and overall climate awareness of programs and policies implemented by state agencies. Regular reporting is a key component for ensuring transparency and accountability in state operations and establishing trust in the efficacy and effect of climate adaptation initiatives. Metrics should be developed to track progress in the following areas:

Changing Climate Conditions

Once key risks are identified, metrics should be identified to track the progress and occurrence of change. Climate impact metrics are used to track relevant climate conditions in order to understand the rate and magnitude of climate impacts on a plan or investment. Climate impact metrics should include the climate-informed planning parameters discussed in Step 2.



To develop Climate Impact Metrics, agencies should consider the following guidance:

» Employ Cal-Adapt to identify climate risks of particular concern in a given location,
» Consult the *Indicators of Climate Change in California* report for observed changes and impacts that may be relevant to a given location,
» Identify topic areas or populations of high priority,
» Consider a worst case scenario as a benchmark against which to track changing climate conditions.

Resilience Outcomes

To understand the performance of plans and projects, it is important to develop a set of metrics linked to the management objectives of a plan or investment under current and changing climate conditions. These resilience metrics should align with management objectives for a given plan or project, as well as the overall resilience of that plan or project. State entities should maintain a list of specific actions taken and track their effect on resilience, such as acres of wetlands conserved to buffer sea level rise, increase in urban tree canopy cover to reduce energy demand and help cool cities, and number of cooling centers provided to communities that may lack air conditioning.

Climate Awareness

As agencies take steps to integrate climate information into planning and investment, these efforts should be tracked alongside other sustainability metrics. Agencies should track the number of plans and projects that incorporate climate change by developing a process to track and document State agencies' use of climate information and implementation of this guidance document in planning and investment.

Aggregating and Tracking Metrics

Support for the development of these metrics and their aggregation will be completed though several processes:

Safeguarding California

The sector leads for the Safeguarding California report will identify climate impact and state action metrics through the development of

Metrics Development Guidelines

Identify what metrics and parameters the agency would like to use if sufficient data existed, work from those to develop metrics that are feasible given data and resource limitations.

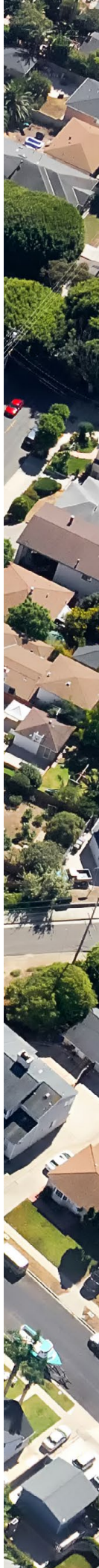
Explore existing data and resources available.

Determine frequency of data collection and methods by which the data or information would be collected

Develop a monitoring and evaluation plan for metrics, including review and revision as needed.

Where possible, metrics should incorporate and highlight:

» Equity, human health, and environmental justice impacts of an adaptation action or climate impact.
» Linkages to the high-level sector metrics in the 2017 *Safeguarding California* plan.
» Use of natural infrastructure solutions.



Implementation Action Plans. These metrics will include the climate-relevant planning parameters. This work can also be supported by the Climate Action Team Research Working Group.

State sustainability efforts

The Government Operations Agency will develop a system for tracking progress on implementing this guidance; this will include integration into ongoing State sustainability tracking and monitoring systems.

Cal-Adapt

Continued investment in Cal-Adapt will provide State agencies with climate change information to support the development of climate impact metrics.

Climate Change Assessment

The State's investment in climate change assessments that provide updated information on climate impacts will support further development of Cal-Adapt and State agency efforts to integrate climate change information.

California @ 50 Million Indicator Dashboard

The Governor's Office of Planning and Research is developing an indicator dashboard that will provide an portal to access data and information on metrics.

Office of Environmental Health Hazard Assessment Climate Indicators report

The Office of Environmental Health Hazard Assessment collects and regularly updates information on changing climate conditions and their impacts.

Examples of Metrics

California State Wildlife Action Plan

State Water Plan

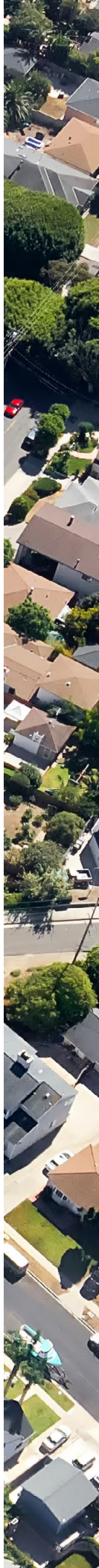
Fire and Resource Assessment Program

Energy Commission Tracking Progress

OEHHA: Indicators of Climate Change in California

Safeguarding California Implementation Action Plan Status Updates

CA@50 Million



Case Studies

Many State agencies are already taking steps to integrate climate change into planning and investment. The examples below provide a snapshot of the approaches employed in different planning contexts.

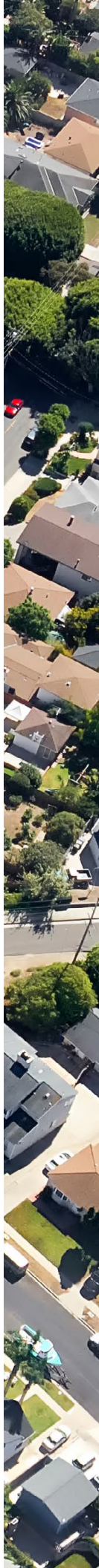
California Water Plan 2013

The California Water Plan helps implement the State's Water Action Plan. In the 2013 update to the Water Plan, the Department of Water Resources (DWR) employed a scenarios approach to identify a range of possible futures, reflecting the uncertainty in climate change, but also to capture uncertainty and variability in future demographics, land use, economic change, and other factors. These scenarios are used to test how different management strategies perform across a range of future conditions.

For this analysis, DWR selected 22 future climate scenarios to include this their analysis. Together, these scenarios provide a range of future temperature and precipitation levels that could be experienced in the future. Combined with different growth scenarios, DWR analyzed outcomes for water management under 198 possible future conditions. This analysis uses Robust Decision Making (RDM) to identify key future vulnerabilities of the current management approach to urban and agricultural reliability, groundwater storage, and environmental flows in the Central Valley. It next evaluates how response packages, comprised of different management strategies, might reduce these vulnerabilities. Lastly, it presents key trade-offs among the different response packages in terms of their cost and their ability to reduce vulnerabilities.

This analysis is intended to identify high-level long-term vulnerabilities of the Central Valley water-management system and then evaluate how different combinations of management strategies could reduce these vulnerabilities. It is not intended to inform specific investment or management decisions. Instead, it seeks to provide a quantitative understanding of the range of future conditions, the severity of future challenges, and a rough estimate of how some strategies could improve future outcomes.

Resources: http://www.water.ca.gov/waterplan/docs/cwpu2013/Final/06_Vol1_Ch05_Managing_an_UncertainFuture.pdf



California High Speed Rail Authority

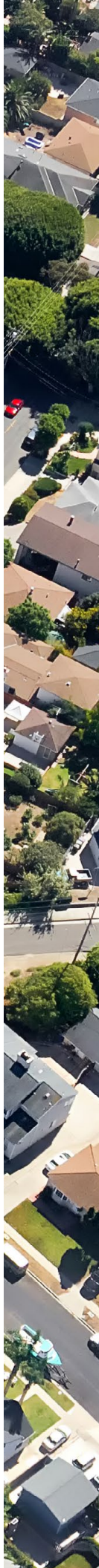
Designing, constructing, and operating a system that is resilient to future climate change is one element of the California High Speed Rail Authority's (HSRA) sustainability framework. To realize this objective, HSRA has undertaken several approaches to understand how climate change impacts could affect the high-speed rail system. This work has been completed early in system delivery. HSRA has considered risks from increasing average temperatures and extreme heat events, increasing wildfire risk, and sea level rise and storm surge. In some instances, HSRA has employed a single global climate model, and in other analyses, has looked at a range of models. HSRA has considered high and low emission scenarios, as well as baseline and extreme scenarios. The Authority is incorporating these analyses into system planning, design, and operations and maintenance to increase system reliability and mitigate risks under future climate conditions.

For more information:
http://hsr.ca.gov/docs/programs/green_practices/sustainability/Sustainability_Report_Dec_2016.pdf

Strategic Growth Council Grant Guidelines for AHSC

The Strategic Growth Council (SGC) supports sustainable communities and land conservation through several different programs funded through the Greenhouse Gas Reduction Fund. Although the program's primary objective is to reduce greenhouse gas emissions, SGC's programs provide an opportunity to promote integrated climate action. To support this, SGC has started to integrate climate adaptation and resilience as a competitive scoring criteria for the Affordable Housing and Sustainable Communities (AHSC) grant program. All AHSC applicants were to address climate adaptation into project design, and were directed to state adaptation data and resources. These resources include Cal-Adapt, the Adaptation Planning Guide, and Safeguarding California. Looking ahead, SGC is working to refine and expand its guidance to further integrate climate adaptation and resilience in capital projects it funds.

Resource: Final AHSC Guidelines, 2015-16:
http://sgc.ca.gov/resource%20files/FINAL15-16AHSCGuidelines&QM.pdf



Climate-Informed Infrastructure Investment

EO B-30-15 specifically directs State agencies to integrate climate change into infrastructure investment, and in doing so to employ full life-cycle cost accounting and to prioritize natural and green infrastructure solutions.

This section of the guidance applies the guidance in the previous sections to the State's infrastructure investments. California makes infrastructure investments through several mechanisms, which include the following:

- Support – funding of systems like telecommunications or onsite renewable energy that is not considered traditional capital "infrastructure";
- Local Assistance – full or partial funding for the development, construction, maintenance and/or operations of infrastructure not owned by the state (e.g. local government, NGOs, private sector) either through grants or a financing instrument (i.e., loan programs like the I-Bank; Treasurer's Office's tax incentives, etc.), and;
- Capital Outlay – funding to study, design, acquire land, and construct and maintain infrastructure that is owned by the state.

Climate change needs to be considered in all of these activities. For all infrastructure projects, State agencies should adhere to the following guidelines.

Prioritize Natural Infrastructure

For all infrastructure projects, agencies should evaluate if there is an opportunity to utilize natural infrastructure – either to fully accomplish the desired project goal, or as a component of the project.

- Assess the landscape of the project area to identify the presence and location of natural lands, corridors, natural systems and ecosystem functions.
- Use Cal-Adapt (cal-adapt.org) to determine any possible impacts that could affect the project location.
- Determine if a Natural Infrastructure solution(s) can be applied to the project, and if it would contribute to one or more of the following benefits:
  - Maintain or increase the level of the ecological services within the project that are delivered through natural systems (i.e. forests, rivers, wetlands), or protect the capacity of these systems to reduce the effects of future anticipated climate impacts.
  - Additional benefits to water and soil (e.g. through engineered wetlands or improved field margins), or improvements in air quality.
  - Increased energy and water efficiency, reduction or avoidance of carbon emissions, or increased carbon sequestration over the use life of the project.
  - Habitat protection, creation, or restoration, and/or the ability to facilitate wildlife movement and connect wildlife populations.
- Consult with state department, local governments and other organizations working on natural infrastructure solutions to learn about Natural Infrastructure design, best practices and case studies that might be workable for the project.
- Engage with local, regional and state partners about their climate priorities and current efforts to incorporate protect, conserve and restore natural systems
- Compare the risk reduction potential and the full benefits and full costs with the initial project proposal per subsection below on Full Life-cycle accounting. *If the performance and cost/benefit of the natural infrastructure alternative are equal to or better than those of the initial proposed project, proceed with the natural infrastructure alternative or document a finding of overriding considerations.*

Employ Full Life-Cycle Cost Accounting

Executive Order B-30-15 directs State agencies to use full life-cycle cost accounting for all infrastructure projects. Life-cycle cost accounting (LCCA) is a method of analysis that integrates all costs arising from owning, operating, maintaining, and ultimately disposing of a project. LCCA is most useful in comparing the costs of projects that will meet the same performance requirements, but alternatives different initial and operating costs.[18]

The intention of employing full life-cycle costs accounting in the context of climate change is to fully account for the cost of maintaining and operating an investment over its lifetime and with changing climate conditions, including extreme events. Such an analysis will include the costs of building in a more resilient manner to withstand future climate conditions and/or account for any investments that will be needed over the life of an investment to withstand changing climate conditions.

An LCCA should include the following elements:

Development of design and performance criteria that reflect climate change

The LCCA must be based on design and performance criteria that reflect future climate projections for temperature, precipitation, sea level rise, and other factors relevant to the project under consideration. These should be developed using the risk management approach outlined in Step 2.

Initial costs, including land acquisition and construction costs

This should include location and construction alternatives designed to be resilient under future climate conditions.

Maintenance and operating costs, including the cost to maintain and operate under future climate conditions for each construction alternative

In some cases, this could include retrofit to an initial design to account for future climate conditions.

18. Fuller, Sieglinde. 2016. Life-Cycle Cost Accounting. Whole Building Design Guide. Available online: https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca

Consideration, at least qualitatively, of non-monetary costs and benefits

This can include using non-market evaluation methods such as travel cost, avoided costs or contingent valuation to capture hard-to-quantify benefits and costs such as those from recreation, biodiversity enhancement including costs and benefits conferred to natural systems and communities. Flexibility in the face of change and surprises should also be considered.

Consideration of a full project lifetime

Costs should be accounted for over the full, expected life of a project, not only the financing period.

Analysis of costs using a range of discount rates

A discount rate is needed to allow aggregation of costs over the full lifetime of a project. A higher discount rate places less value on impacts and costs that are further out in time, while a lower discount rate puts more weight on those costs.

Prioritize Infrastructure with Integrated Climate Benefits

Prioritize and select infrastructure options using the following criteria:

- Select options that are consistent with overall project objectives, while minimizing net GHG emissions and capitalizing on opportunities to increase carbon sequestration in the natural and built environments,
- Demonstrate a preference for flexible and adaptive solutions that will allow for adjustment as the climate changes and/or surprises emerge, and
- Maximize benefits conferred to vulnerable communities and individuals, and are consistent with overall project objectives.

Integrate Resilient Decision Making Principles and Infrastructure Investment

State agencies proceed through the following steps when making investments in State-owned infrastructure: study phase, design phase, construction, and maintenance and operation. The table below outlines how climate change should be integrated into each phase.

Infrastructure Investment Phase	Climate Activities	Supporting Resources
Study Phase	Answer screening questions to determine whether to consider climate change	TAG Guidance Document
	Assess climate vulnerabilities and determine exposures and risks	Cal-Adapt Indicators of Climate Change in California Infrastructure-specific vulnerability assessments
	Determine if asset will be in current or future coastal zone	Cal-Adapt/CoSMoS
	Identify local and regional plans and policies; key stakeholder groups	Outreach and engagement
	Identify vulnerable populations	Characteristics of vulnerability, or CalEnviroScreen, Healthy Places Index, or Regional Opportunity Index
	Identify potential impacts on public health and vulnerable populations	Heat island index County Climate Change and Health Profiles
	Integrate climate change into cost estimation	Life-cycle Cost Accounting
	Identify metrics for tracking project performance	Examples and sources below
	Engage local and regional agencies, community groups, and other stakeholders	
Design Phase	Use climate scenarios to quantify climate-informed planning parameters	Cal-Adapt
	Identify all project alternatives, including natural and green infrastructure options as part of project or project mitigation per guidance on Principle 4	Infrastructure checklist
	Evaluate co-benefits of each alternative	
	Use metrics to evaluate each project alternative. Where equivalent, prioritize natural infrastructure option	
	Identify points over the project lifetime for evaluation of adaptive management, if needed	
	Engage local and regional agencies, community groups, and other stakeholders	
	Complete the Equity Checklist	Equity Checklist - Appendix C
Construction Phase	Implement features and strategies developed in the design phase	
Maintenance and operation	Collect and report all metrics developed in the design phase	
	Adjust and adapt project design and/or operation as needed	

Maintaining a Living Document

Several ongoing processes will provide support in both implementing the guidance document and serve as a means for updating and maintaining it as a living document. These processes will also provide opportunities for agencies to work together and learn from one another as they implement this guidance. These include, but are not limited to, the following:

Sustainability Task Force

lead: Government Operations Agency

The Sustainability Task Force is building adaptation into department sustainability roadmaps, which will put this guidance into action, especially around state-owned and -leased facilities.

Safeguarding California

lead: California Natural Resources Agency

Safeguarding California provides the framework for preparing for climate impacts. Regular updates will support agency implementation of the TAG Guidance and development of metrics to track progress. This will also include the implementation of Senate Bill (SB) 2800, which will provide support for climate-smart infrastructure.

Integrated Climate Adaptation and Resilience Program

lead: OPR

The Integrated Climate Adaptation and Resilience Program, developed under Senate Bill 246, provides a venue for State, local, and regional coordination on climate adaptation. This will include work on guidance, financing, and other implementation activities. The Program has two components:

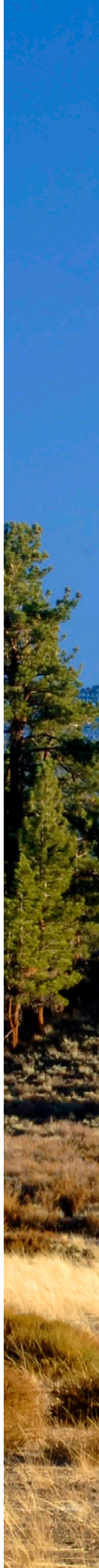
- A Technical Advisory Council: The Technical Advisory Council has a unique coordination role and can support ongoing efforts by State agencies, while also providing a public venue to support outreach and coordination with local and regional agencies. Quarterly meetings of the TAC will occur and discussion of implementation of this section of the EO may be included.
- A Clearinghouse of Resources to Support Adaptation Efforts: OPR will host a clearinghouse of information to support local and regional climate actions.

Climate Action Team (CAT)

lead: CalEPA

The Climate Action Team is an important venue for cross-agency collaboration on climate activities. In addition to the larger group, several sub-groups will support TAG implementation, including:

- The Research Working Group: Assist with guidance on analytical approaches, data selection, and research coordination
- Safeguarding CAT: Provide a venue for cross-sector collaboration and information sharing on development of the Safeguarding California plan, TAG guidance implementation, and engagement with local and regional agencies.
- At least one meeting per year of the Public Health Workgroup (PHWG) of the Climate Action Team will include a discussion of implementation of the equity section of the EO.
- Other subject matter CAT working groups



Strategic Growth Council (SGC)

SGC has direction to review the 5-Year Infrastructure Plan and other state program activities for consistency with State climate goals, including adaptation and resilience. The projects in the Five-Year Infrastructure Plan should all follow this guidance.

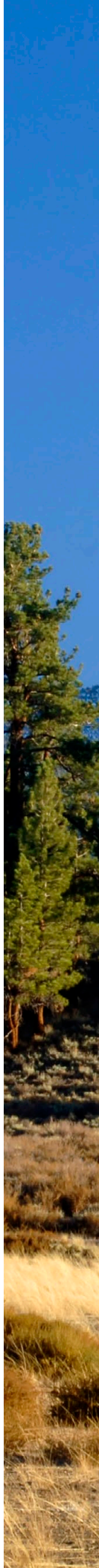
Climate Change and Health Equity Program of the California Department of Public Health (CDPH)

The Climate Change and Health Equity Program staff will be available to support implementation of the equity principle in this guidance. Staff will be available to answer questions, provide limited support or technical assistance to state agencies, and contribute to revisions of the guidance as feedback is collected.

Climate Change Assessment program

leads: Califonria Natural Resources Agency, California Energy Commission

California's Fourth Climate Assessment is underway and studies will be complete in 2018. The Assessment program will continue to support development of policy-relevant data and studies, and will generate data and other information to be integrated into Cal-Adapt, as resources allow. The State will continue to pursue additional opportunities to make climate data accessible and available through Cal-Adapt and other tools.

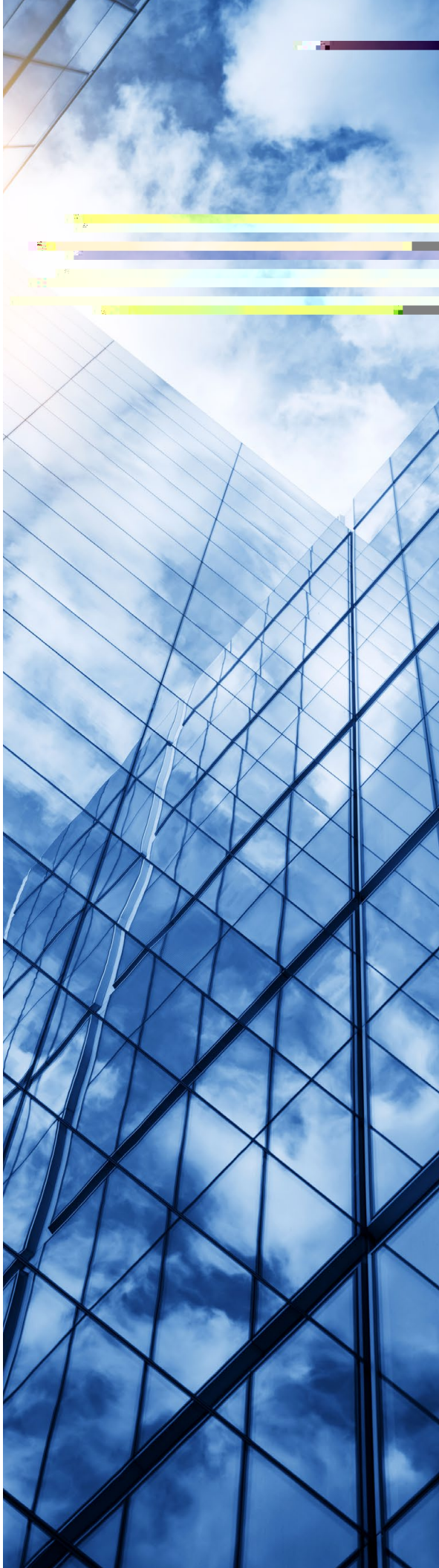


Appendix A
Text of Executive Order B-30-15

WHEREAS climate change poses an ever-growing threat to the well-being, public health, natural resources, economy, and the environment of California, including loss of snowpack, drought, sea level rise, more frequent and intense wildfires, heat waves, more severe smog, and harm to natural and working lands, and these effects are already being felt in the state; and

WHEREAS the Intergovernmental Panel on Climate Change concluded in its Fifth Assessment Report, issued in 2014, that "warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia" and that "continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems;" and

WHEREAS projections of climate change show that, even under the best-case scenario for global emission reductions, additional climate change impacts are inevitable, and these impacts pose tremendous risks to the state's people, agriculture, economy, infrastructure and the environment; and



WHEREAS climate change will disproportionately affect the state's most vulnerable citizens; and

WHEREAS building on decades of successful actions to reduce pollution and increase energy efficiency the California Global Warming Solutions Act of 2006 placed California at the forefront of global and national efforts to reduce the threat of climate change; and

WHEREAS the Intergovernmental Panel on Climate Change has identified limiting global warming to 2 degrees Celsius or less by 2050 as necessary to avoid potentially catastrophic climate change impacts, and remaining below this threshold requires accelerated reductions of greenhouse gas emissions; and

WHEREAS California has established greenhouse gas emission reduction targets to reduce greenhouse gas emissions to 1990 levels by 2020 and further reduce such emissions to 80 percent below 1990 levels by 2050; and

WHEREAS setting an interim target of emission reductions for 2030 is necessary to guide regulatory policy and investments in California in the midterm, and put California on the most cost-effective path for long term emission reductions; and

WHEREAS all agencies with jurisdiction over sources of greenhouse gas emissions will need to continue to develop and implement emissions reduction programs to reach the state's 2050 target and attain a level of emissions necessary to avoid dangerous climate change; and

WHEREAS taking climate change into account in planning and decision making will help the state make more informed decisions and avoid high costs in the future.

NOW, THEREFORE, I, EDMUND G. BROWN JR., Governor of the State of California, in accordance with the authority vested in me by the Constitution and statutes of the State of California, in particular Government Code sections 8567 and 8571 of the California Government Code, do hereby issue this Executive Order, effective immediately

IT IS HEREBY ORDERED THAT:

1. A new interim statewide greenhouse gas emission reduction target to reduce greenhouse gas emissions to 40 percent below 1990 levels by 2030 is established in order to ensure California meets its target of reducing greenhouse gas emissions to 80 percent below 1990 levels by 2050.

2. All state agencies with jurisdiction over sources of greenhouse gas emissions shall implement measures, pursuant to statutory authority, to achieve reductions of greenhouse gas emissions to meet the 2030 and 2050 greenhouse gas emissions reductions targets.

3. The California Air Resources Board shall update the Climate Change Scoping Plan to express the 2030 target in terms of million metric tons of carbon dioxide equivalent.

4. The California Natural Resources Agency shall update every three years the state's climate adaptation strategy, Safeguarding California, and ensure that its provisions are fully implemented. The Safeguarding California plan will:

-Identify vulnerabilities to climate change by sector and regions, including, at a minimum, the following sectors: water, energy, transportation, public health, agriculture, emergency services, forestry, biodiversity and habitat, and ocean and coastal resources;
-Outline primary risks to residents, property, communities and natural systems from these vulnerabilities, and identify priority actions needed to reduce these risks; and
-Identify a lead agency or group of agencies to lead adaptation efforts in each sector.

5.Each sector lead will be responsible to:

-Prepare an implementation plan by September 2015 to outline the actions that will be taken as identified in Safeguarding California, and
-Report back to the California Natural Resources Agency by June 2016 on actions taken.

6.State agencies shall take climate change into account in their planning and investment decisions, and employ full life-cycle cost accounting to evaluate and compare infrastructure investments and alternatives.

7.State agencies' planning and investment shall be guided by the following principles

-Priority should be given to actions that both build climate preparedness and reduce greenhouse gas emissions;

-Where possible, flexible and adaptive approaches should be taken to prepare for uncertain climate impacts;

-Actions should protect the state's most vulnerable populations; and
-Natural infrastructure solutions should be prioritized.

8.The state's Five-Year Infrastructure Plan will take current and future climate change impacts into account in all infrastructure projects

9.The Governor's Office of Planning and Research will establish a technical, advisory group to help state agencies incorporate climate change impacts into planning and investment decisions.

10.The state will continue its rigorous climate change research program focused on understanding the impacts of climate change and how best to prepare and adapt to such impacts.

This Executive Order is not intended to create, and does not, create any rights or benefits, whether substantive or procedural, enforceable at law or in equity, against the State of California, its agencies, departments, entities, officers, employees, or any other person.

I FURTHER DIRECT that as soon as hereafter possible, this Order be filed in the Office of the Secretary of State and that widespread publicity and notice be given to this Order.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this 29th day of April 2015.

_____

EDMUND G. BROWN JR.
Governor of California

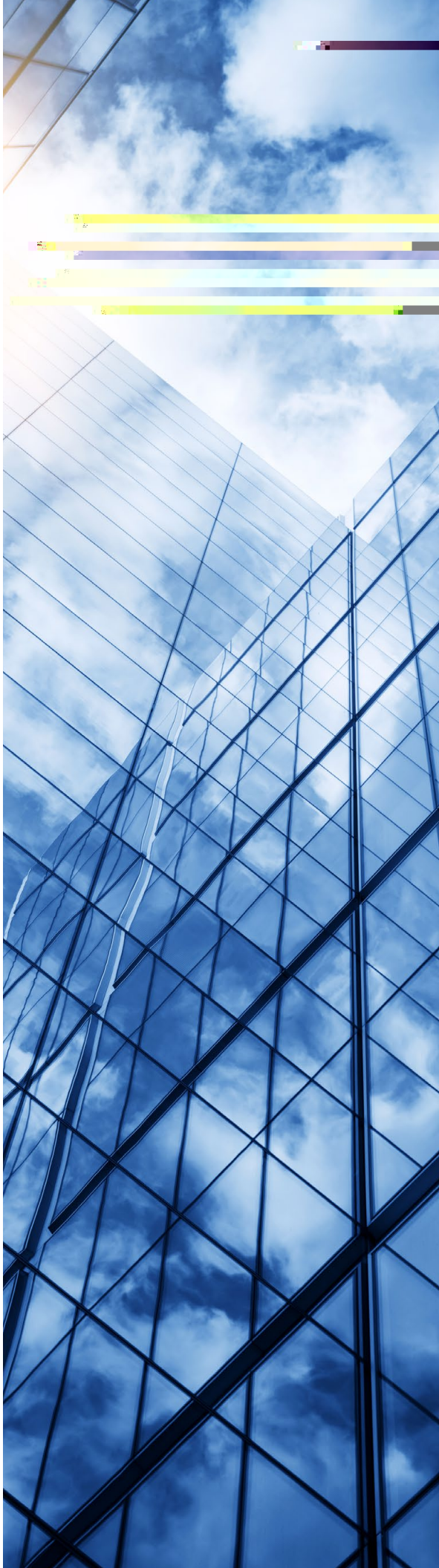
ATTEST:

_____

ALEX PADILLA
Secretary of State

Appendix B
Technical Advisory Group Membership

Abe Doherty	Ocean Protection Council
Aleka Seville	Four Twenty Seven Climate Solutions
Alex Leumer	The Nature Conservancy
Alex Ghenis	World Institute on Disability
Allison Brooks	Bay Area Regional Collaborative
Allison Wood	San Diego Regional Collaborative
Amrith Gunasekara	California Department of Food and Agriculture
Andrew Jones	Lawrence Berkeley National Laboratory
Andrew Schwarz	Department of Water Resources
Annika Ragsdale	Parsons Brinckerhoff/High Speed Rail Authority
Arsenio Mataka	California Environmental Protection Agency
Ashley Conrad-Saydah	California Environmental Protection Agency
Ben Russak	Liberty Hill Foundation
Brian Beveridge	West Oakland Environmental Indicators Project
Bruce Riordan	University of California Berkeley
Camille Kirk	University of California Davis
Chris Lief	California Department of Finance



Christina Curry	Governor's Office of Emergency Services
Claire Jahns*	California Natural Resources Agency
Colin Bailey	Environmental Justice Coalition for Water
Curtis Alling	Ascent Environmental
Dan Burgoyne	California Department of General Services
Desiree Fox	California Department of Transportation
Elizabeth Grassi*	Strategic Growth Council
Ellen Wu	Urban Habitat
Emilie Mazzacurati	Four Twenty Seven Climate Solutions
Greta Soos	Governor's Office of Planning and Research
Guido Franco	California Energy Commission
Jamesine Rogers Gibson	Union of Concerned Scientists
Jana Ganion	Blue Lake Rancheria
Julia Ekstrom	University of California Davis
Jelena Hartman	State Water Resources Control Board
Joey Wall*	California Natural Resources Agency
John Blue	California Environmental Protection Agency
Jonathan Parfrey	Climate Resolve
Jose Lara	Governor's Office of Emergency Services
JR DeLaRosa	California Natural Resources Agency
Kamyar Guivetchi	California Department of Water Resources
Kate Meis	Local Government Commission
Kate White	California State Transportation Agency
Kathleen Ave	Sacramento Municipal Utility District
Kathy Dervin	Public Health Institute
Kerri Timmer	SierraCAMP
Kevin Masuhara	California Department of Food and Agriculture
Kim Carr	California Department of Forestry and Fire Protection
Kim Danko	Strategic Growth Council
Kirsten Andrews-Schwind	Resilient Communities Initiative
Kit Batten	Pacific Gas & Electric
Kristin Ralff-Douglass	Public Utilities Commission
Larry Green	Alliance of Regional Collaboratives for Climate Adaptation
Linda Helland*	California Department of Public Health
Linda Rudolph	Public Health Institute
Lisa Bates	Department of Housing and Community Development
Louis Blumberg	The Nature Conservancy
Louise Bedsworth	Governor's Office of Planning and Research
Margaret Gordon	West Oakland Environmental Indicators Project

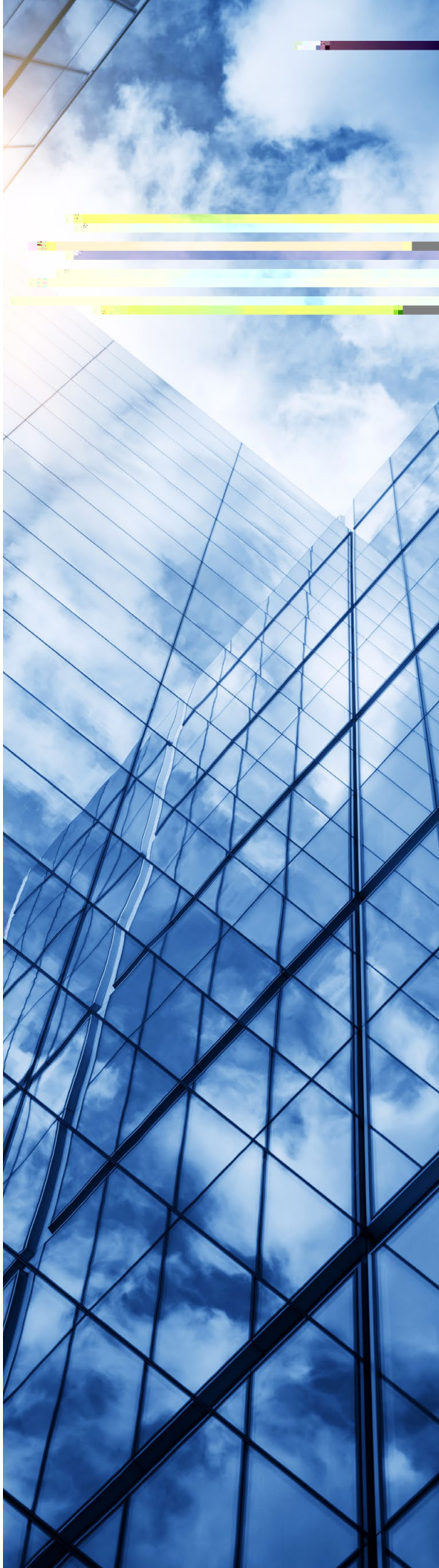
Marianna Grossman	Minerva Ventures
Marlon Flournoy	California Department of Transportation
Mary Simmerer	Department of Water Resources
Matt Henigan	Government Operations Agency
Meg Cederoth	High Speed Rail Authority
Megan Walton	California Office of Emergency Services
Melissa Thompson	California Department of Transportation
Michael McCormick*	Governor's Office of Planning and Research
Michael-Gerold Neumann	City of Roseville
Nuin-Tara Key	Governor's Office of Planning and Research
Paige Berube	Ocean Protection Council
Paul McDougall	Department of Housing and Community Development
Samuel Diaz	Governor's Office of Planning and Research
Solange Gould	California Department of Public Health
Sonya Ziaja	California Energy Commission
Tracy Delaney	Public Health Alliance of Southern California

*Working Group leads

Appendix C
Equity Checklist

The following checklist is intended to assist State agencies to ensure that plans and investments identify and protect the State's most vulnerable populations, as explained in Principle 2.

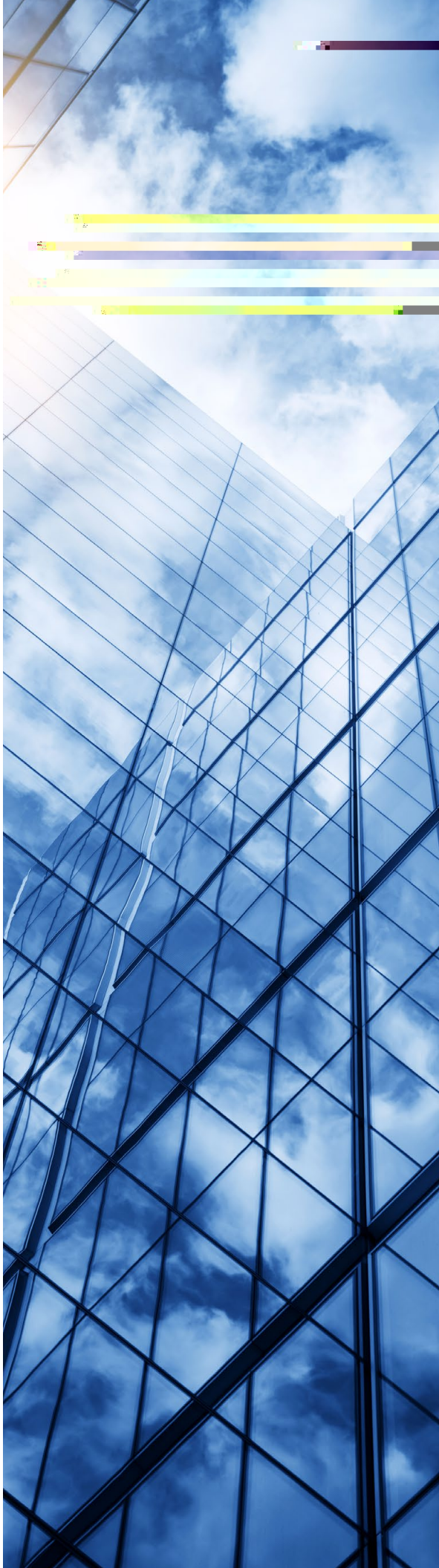
- Which vulnerable populations may be impacted by or could benefit from your policy, initiative, program or budget?
  - Have you identified these populations based on population characteristics,location, or both?
- Have you designed a process to collaborate with vulnerable populations?
  - Which best practices for meaningful engagement are you implementing (see Community Engagement Best Practices)?
  - Are you sharing as much decision-making power as feasible (see Spectrum of Public Participation)?
  - Is there a need for formal agreements to define collaboration, and if so how will you develop them (see an example partnering agreement)?
- How may the policy, initiative, program or budget increase racial equity?
- How may the policy, initiative, program or budget decrease inequality in income or wealth?



- How may the policy, initiative, program or budget ensure safety and improve health outcomes for vulnerable populations, including people with disabilities?
- What mechanisms will you use to assure particular benefit to low income or otherwise vulnerable populations? For example:
  - Provide extra financial incentives, investments, or resources
  - Provide higher levels of service
  - Provide capacity building or training
  - Provide jobs
- What mechanisms will you use to assure that vulnerable communities are prioritized for employment and job training in carrying out your project?
- Are you including health objectives in your policy, initiative, budget, or program's development and implementation?
- Have you included public health staff, agencies or organizations during the development and implementation of your policy, initiative, program or budget?
- Does your policy, initiative, program or budget have dedicated set-asides for vulnerable communities?
- What unintended consequences may result for vulnerable populations and how will you address them?
- How will your project, plan or program provide for local capacity building?
- How will your project, plan or program increase the quality, efficiency and effectiveness of existing operations?
- How will you evaluate the equity impact of your program or policies?
- How will you communicate progress to all stakeholders?

Appendix D
Resources to Support Resilient Decision Making

This appendix provides discussion and links to additional resources that expand on the principles outlined in this guidance document. These resources can provide additional information to assist State agencies in implementing this guidance.



Name	Description	Link
State adaptation overview		
Safeguarding California	California developed the first state-level, multi-sector adaptation strategy in 2009. Since then, the State has continued to develop and update this plan, which is now titled the Safeguarding California Plan. The plan identifies climate change risks and vulnerabilities across sectors, and identifies actions necessary to reduce vulnerability and risk. The Safeguarding California Plan should serve as a basis for adaptive planning at the State level.	resources.ca.gov/climate/safeguarding/
Projecting change		
Climate Change Indicators Report	The Climate Change Indicators report presents a compilation of environmental indicators that collectively describe changes to California's climate, the drivers of these changes, and the impacts of such changes on the state.	oehha.ca.gov/climate-change/document/indicators-climate-change-california
Cal-Adapt	The most current selection of GCMs and emissions scenarios can be found on Cal-Adapt, an online tool that displays climate impacts in a spatial format, and makes the underlying data available for download. To ensure consistency in planning for climate impacts, State agencies are directed to use Cal-Adapt to access the latest climate change information.	cal-adapt.org/
Projecting change (continued)		
CoSMoS	The Coastal Storm Modeling System (CoSMoS) is a dynamic modeling approach that has been developed by the United States Geological Survey in order to allow more detailed predictions of coastal flooding due to both future sea level rise and storms integrated with long-term coastal evolution.	walrus.wr.usgs.gov/coastal_processes/cosmos/
State's Climate Change Assessment	California produces periodic scientific assessments on the potential impacts of climate change in California and reports potential adaptation responses. The Fourth Climate Change Assessment is the first inter-agency effort to implement a substantial portion of the Climate Change Research Plan, which articulates near-term climate change research needs to ensure that the state stays on track to meet its climate goals.	climatechange.ca.gov/climate_action_team/reports/climate_assessments.html
State of California Sea-Level Rise Guidance Document	The State of California Sea-Level Rise Guidance Document Guidance provides information and recommendations to enhance consistency across agencies in their development of approaches to sea-level rise.	
Promoting equity		
CalEnviroScreen 3.0	CalEnviroScreen is a mapping tool that helps identify California communities that are most affected by many sources of pollution, and where people are often especially vulnerable to pollution's effects. CalEnviroScreen uses environmental, health, and socioeconomic information to produce scores for every census tract in the state.	oehha.ca.gov/calenviroscreen

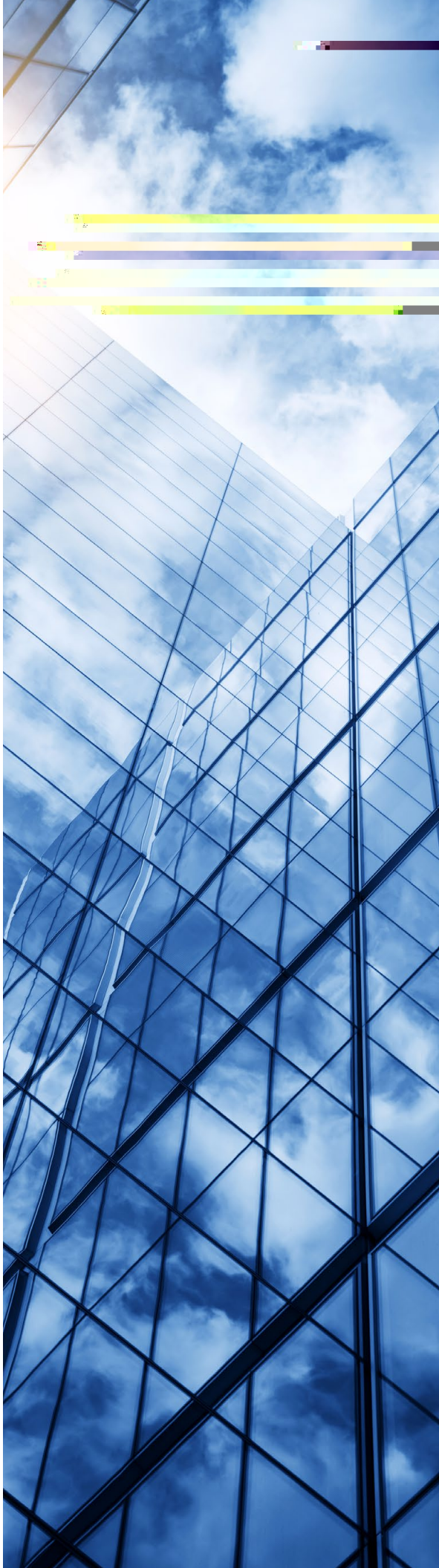
Name	Description	Link
Healthy Places Index	The California Healthy Places Index (HPI) is an interactive online data and GIS mapping tool that allows users to easily visualize the social and economic conditions that shape health in each neighborhood in California. HPI is validated with life expectancy and provides census tract rankings across the state. As of 2017, the Healthy Places Index platform also includes climate change indicators. This tool provides graphic overlays of climate risks, vulnerabilities and indicators of adaptive capacity, along with the healthy places index score, and other key decision support layers. HPI moves data into action by providing policy briefs outlining best practices to address risks associated with climate indicators	healthyplacesindex.org
Regional Opportunity Index	The Regional Opportunity Index (ROI) is an index of community and regional opportunity for understanding social and economic opportunity in California's communities. The ROI incorporates both a "people" component and a "place" component, integrating economic, infrastructure, environmental, and social indicators in to a comprehensive assessment of the factors driving opportunity.	interact.regionalchange.ucdavis.edu/roi/
Climate Change and Health Profile Reports	The Climate Change and Health Profile Reports are designed to help counties in California prepare for the health impacts related to climate change through adaptation planning. The reports present projections for county and regional climate impacts, the climate-related health risks, and local populations that could be vulnerable to climate effects.	www.cdph.ca.gov/Programs/OHE/Pages/ClimateHealth-ProfileReports.aspx
Equity Checklist	The Equity Checklist developed specifically for this guidance is intended to assist State agencies ensure that plans and investments are identifying and protecting the State's most vulnerable populations.	(See Appendix C for Checklist)
Coordinating with local and regional agencies		
Alliance of Regional Collaboratives for Climate Adaptation	The Alliance of Regional Collaboratives for Climate Adaptation (ARCCA) represents leading collaborative networks from across California that actively work to advance important adaptation principles by engaging in state policy development, facilitating dialogue between key decision-makers and stakeholders, and creating valuable tools and resources. The network and principles that ARCCA provides are helpful resources to use when considering local and regional effects of a plan or investment decision.	www.arccacalifornia.org/about/
Union of Concerned Scientists	Union of Concerned Scientists (UCS) Climate Resilience Framework and Principles was developed as a resource to decision makers, citizens in conversation with decision makers, and citizens engaged in adaptation work. The resource describes how climate adaptation and mitigation are intrinsically linked and how, together, the create resilience.	www.ucsusa.org/global-warming/prepare-impacts/climate-resilience-framework-and-principles#.WJu4EFUrIdU OR www.ucsusa.org/
Georgetown University Climate Center	The Georgetown Climate Center works extensively with government officials, academics, and an array of stakeholders to analyze the provisions of federal policy relevant to state and local government, work with states on developing innovative new policies, and encourage policymakers to learn from state experience. The Center also hosts the Georgetown Adaptation Clearinghouse, which provides case studies on areas such as water, coastal, transportation, infrastructure and public health sectors, and adaptation planning, policies, laws, and governance.	www.georgetownclimate.org

Appendix E
Glossary of Terms

Adaptation (climate change)
Adjustment in natural or human systems to a new or changing environment. Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.[1]

Adaptation pathways
Adaptation pathways is a planning approach addressing the uncertainty and challenges of climate change decision making. It enables consideration of multiple possible futures, and allows analysis/exploration of the robustness and flexibility of various options across those multiple futures.[2]

Adaptive management
A process of iteratively planning, implementing, and modifying strategies for managing resources in the face of uncertainty and change. Adaptive management involves adjusting approaches in response to observations of their effect and changes in the system brought on by resulting feedback effects and other variables.[3]



Climate change

Climate change refers to a change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use.[4]

Climate scenarios

A plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as the observed current climate.[5]

Climate-informed planning parameter

A factor that is employed in the design, planning, or investment process, that has been scaled to reflect future climate change.

Community based organization

A community-based organization is a group of individuals organized by and for a particular community of people based on shared interests and/or attributes. The community could be defined geographically (e.g. a neighborhood), could contain members from diverse backgrounds, and/or could be defined on the basis of something like religious beliefs or a shared condition. Members may include various stakeholders, such as the public, elected officials, advocacy groups, and business leaders.[6]

Community resilience

Community resilience is the ability of communities to withstand, recover, and learn from past disasters, and to learn from past disasters to strengthen future response and recovery efforts. This can include but is not limited to physical and psychological health of the population, social and economic equity and well-being of the community, effective risk communication, integration of organizations (governmental and nongovernmental) in planning, response, and recovery, and social connectedness for resource exchange, cohesion, response, and recovery.[7]

Disadvantaged communities

Areas disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation, or with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.[8]

Downscaling

Downscaling is a method for obtaining high-resolution climate or climate change information from relatively coarse-resolution global climate models.[9]

Environmental justice

Environmental justice means the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Gov. Code §65040.12[e]).

Equity

Equity is just and fair inclusion into a society in which all can participate, prosper, and reach their full potential. [10]

Equity (climate)

The central equity challenges for climate change policy involve several core issues: addressing the impacts of climate change, which are felt unequally; identifying who is responsible for causing climate change and for actions to limit its effects; and understanding the ways in which climate policy intersects with other dimensions of human development, both globally and domestically.[11]

Extreme (climate) events

The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable.[12]

Global climate models

A numerical representation of the climate system that is based on the physical, chemical, and biological properties of its components, their interactions, and feedback processes, and that accounts for all or some of its known properties.[13]

Institutionalized racism

The structures, policies, practices, and norms resulting in differential access to the goods, services, and opportunities of society by "race." It is normative, sometimes legalized, and often manifests as inherited disadvantage. Examples include differential access to quality education, sound housing, gainful employment, appropriate medical facilities, and a clean environment.[14]

Integrated climate actions

Program, plans, or policies that simultaneously reduce greenhouse gas emissions and decrease the risks posed by climate change on the system where the action is implemented.

Life-cycle cost accounting (analysis)

Life-Cycle Cost Analysis (LCCA) is an economic method of project evaluation in which all costs arising from owning, operating, maintaining, and ultimately disposing of a project are considered to be potentially important to that decision. LCCA is particularly suitable for the evaluation of building design alternatives that satisfy a required level of building performance (including occupant comfort, safety, adherence to building codes and engineering standards, system reliability, and even aesthetic considerations), but that may have different initial investment costs; different operating, maintenance, and repair (OM&R) costs (including energy and water usage); and possibly different lives. However, LCCA can be applied to any capital investment decision in which higher initial costs are traded for reduced future cost obligations. LCCA provides a significantly better assessment of the long-term cost effectiveness of a project than alternative economic methods that focus only on first costs or on operating-related costs in the short run.[15]

Localized Constructed Analogs (LOCA)

LOCA is a technique for downscaling climate model projections of the future climate. The localized constructed analogs (LOCA) method is a statistical scheme that produces downscaled estimates suitable for hydrological simulations using a multi-scale spatial matching scheme to pick appropriate analog days from observations.[16]

Maladaptive actions (maladaptation)

Actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future.[17]

Mitigation (climate change)

A human intervention to reduce the human impact on the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.[18]

Mitigation (of disaster risk and disaster)

The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability.[19]

Natural and green infrastructure

The preservation or restoration of ecological systems, or utilization of engineered systems that use ecological processes, to increase resiliency to climate change, manage other environmental hazards, or both. This may include, but is not limited to, floodplain and wetlands restoration or preservation, combining levees with restored natural systems to reduce flood risk, and urban tree planting to mitigate high heat days.[20]

Non-market costs

Nonmarket costs refer to the costs associated with nonmarket impacts of a project. These impacts may be quantified and monetized using non-market valuation methods such as damage cost estimation, prevention cost estimation, hedonic methods, travel cost methods, or contingent valuation methods.[21]

Representative concentration pathways

Representative Concentration Pathways (RCPs) are four greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. The Representative Concentration Pathways (RCPs), which are used for making projections based on these factors, describe four different 21st century pathways of GHG emissions and atmospheric concentrations, air pollutant emissions and land use. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5).[22]

Resilience (climate)

"Resilience is the capacity of any entity – an individual, a community, an organization, or a natural system – to prepare for disruptions, to recover from shocks and stresses, and to adapt and grow from a disruptive experience."[23]

Sea level rise

The worldwide average rise in mean sea level; may be due to a number of different causes, such as the thermal expansion of sea water and the addition of water to the oceans from the melting of glaciers, ice caps, and ice sheets; contrast with relative sea-level rise.[24]

Urban heat island

The relative warmth of a city compared with surrounding rural areas, associated with changes in runoff, effects on heat retention, and changes in surface albedo.[25]

Vulnerable populations

Vulnerable populations include, but are not limited to women; racial or ethnic groups; low-income individuals and families; individuals who are incarcerated or have been incarcerated; individuals with disabilities; individuals with mental health conditions; children; youth and young adults; seniors; immigrants and refugees; individuals who are limited English proficient (LEP); and Lesbian, Gay, Bisexual, Transgender, Queer, and Questioning (LGBTQQ) communities, or combinations of these populations.[26]

Endnotes

1 "Glossary of Climate Change Terms. Office of Air and Radiation/Office of Atmospheric Programs/Climate Change Division. September 9, 2013 " https://www.epa.gov/climatechange

2 South West Climate Change Portal: Catchment Planning - Using Adaptation Pathway http://www.swclimatechange.com.au/cb_pages/adaptation_pathways.php

3 IPCC Climate Change 2014: Impacts, Adaptation, and Vulnerability http://www.dot.ca.gov/hq/oppd/rescons/guidelines/DP-30_Climate-Change.pdf

4 IPCC Climate Change 2014: Impacts, Adaptation, and Vulnerability https://www.ipcc.ch/report/ar5/wg2/

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23 Rodin, Judith. 2014. *The Resilience Dividend: Being Strong in a World Where Things Go Wrong*. Philadelphia: Perseus Books Group (pages 3-4).

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25 IPCC Climate Change 2014: Impacts, Adaptation, and Vulnerability. https://www.ipcc.ch/report/ar5/wg2/

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