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1021 O Street, Room 1200

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DISCUSSION

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DISCUSSION

CARBON CAPTURE AND STORAGE (INFORMATIONAL ITEM)

Issue 1: Carbon Capture and Storage (Informational Item)

Background

Executive Order B-55-18 established a goal of achieving carbon neutrality no later than 2045 and of achieving and maintaining net negative emissions thereafter. In a 2020 report, Lawrence Livermore National Lab (LLNL) notes that to achieve this goal, the state must remove 125 million tons per year of carbon dioxide from the atmosphere. They also note that the state must increase efforts in emission reduction measures and technologies to reduce existing emissions from large sources such as industry, and also remove carbon from the atmosphere directly.

Carbon capture and storage (also known as sequestration) is the process of capturing carbon dioxide from emissions sources, such as a power plant, cement plant, direct air capture, ethanol fermentation plant or another industrial source, and storing the carbon dioxide. Stored carbon dioxide can be reused in certain processes (including producing certain consumer goods and oil extraction), or it can permanently sequestered to limit emissions into the environment. When carbon dioxide is stored in underground geological formations, the storage is known as geological carbon storage. When carbon dioxide is consumed and stored in vegetation, soils, and water, the storage is known as biological carbon storage.

According to the 2021 Global CCS Institute (GCCSI) Global Status of CCS Report, the earliest example of carbon capture technology being used was in 1972 in Texas at a natural gas processing plant where it supplied CO₂ to a nearby oilfield for enhanced oil recovery. After decades of development and investment, there are 27 commercial-scale carbon capture projects operating worldwide today, capturing a total of 36.6 million tons of carbon per year, an amount equivalent to nearly 9% of California's annual emissions. The majority of global CCS capacity operating today was built prior to 2011, and captures carbon from natural gas processing plants.

In 2010, the California Carbon Capture and Storage Review Panel (formed by the CPUC, CEC, and ARB and composed of experts from industry, trade groups, academia, and environmental organizations) issued findings and recommendations for how to deploy CCS at a greater scale in California. Some of the key findings from that 2010 report included, "Technology currently exists for the safe and effective capture, transport, and geological storage of CO₂ from power plants and other large industrial facilities...There is a need for clear, efficient, and consistent regulatory requirements and authority for permitting all phases of CCS projects in California, including carbon dioxide capture, transport, and storage."

CARB has adopted a carbon capture and storage protocol under the Low Carbon Fuel Standard (LCFS). In 2018, CARB modified its regulations for the LCFS program, enabling fuel production facilities to obtain LCFS credits for fuel generated in conjunction with carbon capture and sequestration systems that reduce emissions associated with the fuel production. In 2020, CARB also published a report on pathways to achieve Carbon Neutrality in California. All scenarios in the report rely on some degree of carbon capture and storage. Recent reports from both the United Nations Intergovernmental Panel on

Climate Change (IPCC) and the National Academies of Sciences, Engineering and Medicine indicate that reducing future emissions may not be sufficient to meet global climate goals, and carbon capture may be a necessary component of strategies to limit emissions from industrial sources.

A recent report from LLNL notes that no carbon capture storage projects are operating in the state. LLNL notes that California's permitting requirements take 5-6 years to complete. Given California's fast-approaching climate deadlines, slow CCS permitting could cause it to be unusable for meeting those goals. The report cites a lengthy environmental review process, a lack of jurisdictional clarity, cross-agency input at local, state and federal levels, and an absence of a joint-review process as key determinants of the lengthy timeline. Furthermore, CCS projects have the potential to emit air pollutants, requiring an Authority to Construct from local air districts. This will in turn trigger a CEQA review, significantly lengthening the review timeline.

As noted previously, carbon capture and storage may also occur at powerplants. The California Energy Commission (CEC) is responsible for activities relating to the state's energy policy and planning, including but not limited to siting large thermal power plant facilities. Thermal powerplant is any thermal electrical generating facility with a capacity of 50 megawatts (MW) or more. Additionally, power plants under the CEC's jurisdiction also include biomass and natural gas technologies. Existing law designates the CEC as the lead CEQA review agency for projects subject to the CEC's powerplant siting review authority.

Most recently, the federal government, the Administration and members of the Legislature has expressed interest in carbon capture technology and projects. For example, in November 2021, the federal Infrastructure Investment and Jobs Act (IIJA) was signed into law. According to the U.S. Department of Energy (DOE), the IIJA will provide approximately \$6.5 billion over five years to support carbon management systems. However, the amount of funding available may depend on the types of technologies authorized at the state level and rules established by DOE for awarding funds. The DOE notes that approximately \$3.5 billion of the funds it received from the IIJA will be allocated to direct air capture hubs and IIJA provisions require DOE to fund multiple types of carbon capture demonstration and pilot projects.

Additionally, the Governor's January Budget proposes a total of \$210 million General Fund (\$110 million in 2022-23 and \$100 million in 2023-24) to deploy advanced technologies or develop novel strategies to reduce emissions at industrial facilities. According to the Administration, eligible projects could include electrification of heating processes that now use natural gas, energy efficiency projects, and deploying carbon capture for use in products (such as concrete). Carbon capture projects with geologic storage and petroleum and gas production facilities would be ineligible.

The LAO notes that limiting the types of eligible projects and sectors that qualify for funding creates a risk that the funds are not used to support the most promising emission-reduction projects and technologies. A more technology- and sector-neutral approach can be especially important when there is uncertainty about which technologies will prove to be most feasible and cost-effective in the long run. The LAO notes that the Legislature could consider modifying the programs and funding in ways that make a broader range of technologies and businesses eligible for the funding, while directing the administration to select projects based on their potential to help achieve long-term GHG reductions in a cost-effective manner.

Additionally, in 2021, the Legislature passed SB 596 (Becker), Chapter 246, Statutes of 2021, which tasked CARB with developing a comprehensive strategy for the state's cement sector to achieve net-zero emissions of GHGs associated with in-state cement use, including funding measures to support demonstration projects that mitigate emissions from cement production facilities. In addition, there are several pending legislative proposals related to carbon capture and sequestration projects, including at industrial facilities, cement facilities, natural gas electric generation facilities and biomass electric generation facilities, that are in various stages of the legislative policy process. The Senate's plan also includes \$200 million for carbon capture and storage.

Staff Recommendation. None. This item is for informational purposes only.

SENATE CLIMATE BUDGET PLAN

Issue 2: Senate Climate Budget Plan

Senate Proposal. The Senate proposes Climate Budget Plan of approximately \$18 billion spread over five years. Key overarching elements of the plan include:

- Build on, and fill in gaps, last year’s budget historic success on climate resilience:
 - Drought and Water Supply Reliability
 - Wildfire Resilience
 - Sea Level Rise
 - Extreme Heat
- Focus on transformative investments that make a difference in the real world.
- Maximize use of Gann Limit exceptions. Approximately 80 percent of these expenditures qualify as “exempt capital outlay” for purposes of the Gann Limit.
- Address climate needs across geographies and demographics.
- Emphasize equity.

The annual breakdown of the plan over five years is as follows:

- 2022-23 \$5.1 billion
- 2023-24 \$5.1 billion
- 2024-25 \$5.3 billion
- 2025-26 \$1.5 billion
- 2026-27 \$1.5 billion

TOTAL: \$18.5 billion

The Senate Climate Budget Plan is comprised of five main packages:

- Water and Drought
- Wildfire
- Sea Level Rise
- Combat Climate Changes in Disadvantaged Communities
- Biodiversity and Outdoor Access for All

The following provides a description of each of the above packages:

- **Water and Drought Package.** Up until now, we have focused on emergency response to drought. The state needs to recognize that climate change has permanently altered our water supply. Fundamental changes to our water system are needed to realign demand, supply, and the flexibility of the system to address long-term climate impacts.

The Senate proposes \$7.5 billion in state and federal funds spread over three years to build a climate resilient water system, as follows:

- \$2 billion to rebalance state water supply and water rights.
 - \$1.5 billion for new California Water Trust to acquire lands with senior water rights from willing sellers.
 - \$500 million to the Department of Conservation for acquisition and repurposing of lands to implement the Sustainable Groundwater Management Act.
- \$1.5 billion to ensure all Californians have safe drinking water.
- \$1.5 billion to improve watershed climate resilience regionally.
- \$1.5 billion for Drought Resilient Water Supply grants, to assist with recycling, stormwater capture, and groundwater cleanup.
- \$1 billion for Flood Management and Dam Safety grants to improve resilience of flood management system and fund public benefit portion dam safety projects.

\$2 Billion to Rebalance State Water Supply and Water Rights. Climate change is impacting hydrology throughout California. Prolonged drought conditions dramatically impact the viability of our fish and wildlife populations. While there are multiple stressors, the diversion of flow for agricultural and urban uses has outstripped what the ecosystem can handle.

California must consider new approaches to help us reduce water demand to improve freshwater flows, enhance habitat conditions, and provide clean drinking water. The Senate's proposal establishes a voluntary water reconciliation program, helping to rebalance the state's water supply and water rights system, rather than relying on the current regulatory processes that have failed to provide adequate flows for decades and do not adequately anticipate changing conditions.

The proposed water rights reconciliation framework prioritizes acquisition of water to reduce the impact of drought and to enhance stream and river conditions. The program uses multi-benefit water management strategies (e.g., protection of instream flows, sustainable groundwater management/recharge, floodplain restoration, and habitat enhancement) and integrates existing objectives in the Administration's Water Resilience Portfolio, Natural and Working Lands Climate Smart Strategy, and the Pathways to 30x30 Report.

The Senate's proposal recognizes that:

- 1) California's water rights are over-allocated and climate change has created an urgent need to protect and enhance flows.
- 2) A science-based approach must be utilized to prioritize and measure ecological outcomes.
- 3) The State Water Resources Control Board (SWRCB) must ensure that any water protected stays protected, as well as the importance of designating an environmental water master to more transparently track and report on ecological conditions in California rivers.

Key conditions for success include:

- A determination by SWRCB and the Department of Fish and Wildlife (DFW) that a streamflow enhancement program — and specific minimal flow conditions — would make a demonstrable improvement in habitat conditions.
- Ensuring that investments align with existing approved fish and wildlife conservation plans including the Central Valley Joint Venture Plan, Klamath Basin recovery plans, and federal salmon recovery plans.
- Utilizing an environmental water master to certify that the projects would improve habitat conditions.
- Taking emergency actions to address climate change and improve habitat conditions for both listed and candidate species.
- Evaluating the impacts on disadvantaged communities, jobs, and local economies. Mitigation of those impacts are eligible for funding under the program.

The Senate Water Rights Proposal contains four elements:

- Fund permanent acquisition of senior water rights in highly stressed watersheds with the water dedicated to the environment or to drinking water supplies for disadvantaged communities. This will entail purchasing land or easements that allow the land to be converted to low water use--habitat, grazing or other guaranteed reductions in water use. Includes both coastal and valley. Acquisitions prioritized based on environmental needs, maximizing benefits.
- Strengthen water rights quantification and enforcement at SWRCB. Currently the state does not have a reliable quantification of water rights or the ability to effectively enforce.
- Grants to SGMA agencies to repurpose farm lands to lower water use to balance groundwater supply and demand. This is the groundwater equivalent of the #1.
- Mitigate third party impacts. Taking land out of production creates local and regional impacts that need to be mitigated through grants.

Program Implementation. The Senate's proposal is a voluntary program to purchase water along prioritized stream segments. Priority is given to permanent acquisitions through land purchases. The program is administered by the Wildlife Conservation Board (WCB), in consultation with SWRCB and DFW. An advisory board, the California Water Trust, will be established to advise program implementation. The advisory board will include members that represent disadvantaged communities, tribes, and environmental organizations. The advisory board will approve program guidelines and priorities. The goal is to retire water use incrementally from multiple water uses in a basin and across wide geographies to help ensure that no region or area served by a water agency is disproportionately impacted. Investments in flow augmentation will be verifiable and result in measurable improvements in flow, temperature and/or water quality. Further, investments will not replace regulatory requirements. Specific program objectives include prioritizing water acquisitions that improve state and federal wildlife refuge conditions, improve instream habitat for fish, and provide clean drinking water for communities.

Funding Allocations:

- \$400 million for the Sacramento River and tributaries, including:
 - Funding to acquire water, prioritizing additional flows to enhance habitat, land retirement, floodplain restoration, provide water for state and federal refuges, sustainable groundwater management/recharge, and conditional multi-year water lease agreements. Strong oversight and enforcement mechanisms are included to assure that water purchased with public dollars is providing public trust benefits.
 - Funding to measure streamflow, including gages and other reporting devices, that improve understanding of flow conditions.
- \$500 million for coastal water sheds, including:
 - Funding for multi-benefit water management projects including sustainable groundwater management/recharge, floodplain restoration, and stream flow enhancement. Funding is prioritized to watersheds with an approved recovery plan. Funding may be used for short- and long-term acquisitions.
 - Funding for monitoring including stream gages.
- \$100 million for the Sacramento-San Joaquin River Delta, including:
 - Funding for voluntary projects that create wetland habitat and improve flood protection. This program shall be designed to provide multiple benefits for ecosystem restoration, including refuge water supplies and flow enhancement actions beyond those included in Phase 1 of the Bay-Delta Water Quality Control Plan Update. The program will use the Delta Independent Science Board to provide monitoring and oversight.
- \$100 million for the San Joaquin River and tributaries, including:
 - Funding for voluntary projects that create wetland habitat, floodplain restoration, sustainable groundwater management/recharge, and provide water for state and federal refuges. This program shall be designed to provide multiple benefits for ecosystem restoration, including refuge water supplies and flow enhancement actions beyond those included in Phase 1 of the Bay-Delta Water Quality Control Plan Update.
- \$200 million to acquire clean drinking water for disadvantaged communities.
- \$100 million to improve water management science and agency coordination, including:
 - Funding to improve scientific evaluation and information sharing between SWRCB, DFW, the California Water Commission, the Delta Independent Science Board, and the Department of Water Resources (DWR).
 - Funding to SWRCB, DFW, and WCB for program implementation, and to establish a statewide environmental water master program.
- \$100 million to mitigate the impacts to local communities, including:
 - Funding to evaluate and reduce the impacts of the program on disadvantaged communities, jobs, and local economies.
- \$500 million to Department of Conservation (DOC) for acquisition and repurposing of lands to implement the Sustainable Groundwater Management Act.
 - The Senate's proposal calls for increasing funds for DOC's Multibenefit Land

Repurposing Program by \$500 million to fund groundwater sustainability projects that reduce groundwater use, repurpose irrigated agricultural land, and provide wildlife habitat.

\$1.5 Billion for Safe and Clean Drinking Water. This funding focuses on low-income water rates and efficiency assistance, as follows:

- \$330 million for water and wastewater, including:
 - Fund the development of a fund expenditure plan that establishes costs, mechanisms, and reasonable staffing needs for the creation of a permanent low-income rate assistance program for water utility bills.
 - Fund the first two years of a statewide low-income rate assistance program.
- \$200 million for direct installation of efficiency improvements that will save water and lower water and sewer bills in low-income households.
 - Programs include, but are not limited to, California Public Utilities Commission's Energy Savings Assistance Program, Department of Community Services and Development (CSD) Low Income Home Energy Assistance Program (LIHEAP) and the the Department of Housing and Community Development's Community Development Block Grant Program.
- \$40 million to CSD's Low Income Household Water Assistance Program (LIHWAP) to help avoid water shutoffs for low-income, undocumented residents with past due balances.
- \$325 for drought resiliency to do the following:
 - Implement minimum drought resiliency measures as recommended in the final "Small Water Systems and Rural Communities Drought and Water Shortage Contingency Planning and Risk Assessment" report and enacted in SB 552 (Hertzberg), Chapter 245, Statutes of 2021.
 - Provide funding for County Drought Advisory Group (CDAG) Report that is not eligible for funding from the Drinking Water State Revolving Fund and assist with planning efforts.
- \$475 million for drought response and investment in water and wastewater infrastructure that improves resiliency and conservation prioritized for low-income communities and communities at risk of experiencing drought impacts, such as:
 - Proactive domestic well impact mitigation program at groundwater sustainability agencies.
 - Providing emergency interim, alternative water supplies.
 - Improvements or repairs to existing water systems at risk of drought and water shortage or that face other challenges resulting from drought conditions.
- \$100 million to DWR to permit DWR to allocate 2021-22 and 2022-23 funding for projects that benefit drinking water.
- \$60 million to SWRCB to support clean energy sources for wastewater treatment facilities in small disadvantaged communities, including the Green Project Reserve Fund, part of the Clean Water State Revolving Fund program.

\$1.5 Billion for Watershed Climate Resilience. A watershed is a basin, or a land area that collects and delivers water to a central point. Water moves through soils, streams, and rivers from upper elevations to lower elevations, and exists at an outflow such as a stream, river, lake, or the ocean. Watersheds are complex and unique containing different topographies, soils, vegetation, and land uses. Watersheds are affected by climate changes that alter the quantity, quality, timing, and distribution of water. The cumulative impacts of past land uses, water withdrawals, and disturbances are all exacerbated by the climate crisis. Changes vary by scale and location in a watershed, but affect the management of downstream uses, and present challenges to the management of watersheds for water quality or supply; protection of cultural resources; biodiversity; productive timber; recreation; and habitat for wildlife and rare species. Various ways to address such impacts may include supporting projects to retain soil moisture and minimize soil loss; decrease the impacts of low flows; mitigate climate change on wetland projects; and help address changes in water flow due to various stresses that impact flow regimes and affect aquatic life. The Senate proposes to appropriate \$1.5 billion over three years to address such impacts on the state's watersheds on a regional level.

\$1.5 Billion for Drought Resilience. The frequency, intensity, and duration of drought events is increasing. This pattern is expected to continue and shift outside of historic trends, making forecasting our water supply and quality more difficult. The impacts of drought on water quality and availability can be severe. Various ways to improve the state's resilience to drought include water recycling, stormwater capture, and groundwater cleanup. The Senate proposes to appropriate \$1.5 billion over three years to support programs and projects to improve communities' resilience to the impacts of drought.

\$1 Billion for Flood Management and Dam Safety. Dams and levees are critical infrastructure. Climate change is creating more severe weather conditions, such as heavier rains that can cause extreme streamflow events. Climate change impacts are likely to affect different factors that influence dam and levee risk — potential impacts of failure can be extensive, such as to public safety, homes, and the economy. Flood waters can disrupt power generation as well as block roads and railways. The Senate proposes to appropriate \$1 billion over three years for flood management and dam safety grants to improve resilience of flood management systems and fund the public benefit portion of dam safety projects.

- **Wildfire Package.** The Senate Wildfire Resilience Package is based on the following principles:
 - Provide funding for a five-year commitment of prevention and resilience funding that aligns with goals in the legislative proposal last year, such as focusing funding on multi-beneficial and regional efforts including enhancing the state's key watersheds that supply a significant amount of water for the state.
 - Work towards the state goal to treat one million acres annually (500,000 acres state/private and 500,000 federal by 2025). The state currently meets only 10 percent of this goal.

- Focus on prevention:
 - Fuels treatment
 - Prescribed burns
 - Home and community hardening.
- Improve data, surveillance, and public safety systems.
- Build capacity at regional level to focus on prevention and resiliency, including state conservancies and the Regional Forest and Fire Capacity Program.
- Develop solutions to biomass accumulation, including new wood utilization strategies.

The Senate proposes to appropriate \$6.6 billion over five years (\$1.32 billion annually) to build on the Governor's wildfire proposals. Among the various components, include:

- \$1.5 billion for fuel reduction.
- \$95 million for biomass accumulation.
- \$35 million for workforce development and training.
- \$675 million for state conservancies.
- \$220 million ongoing to expand staffing ratios to 3.0 for CalFire fire engines.

Spending categories in the Wildfire Package are substantially based on funded categories in the wildfire package approved in the 2021 Budget Act.

- **Sea Level Rise.** The Senate proposes to appropriate \$3.3 billion spread over multiple years to improve adaptation and resilience to sea level rise, including funding to:
 - Over three years, provide \$100 million annually to fund SB 1 (Atkins), Chapter 236, Statutes of 2021, and match available federal funds.

SB 1 established the California Sea Level Rise Mitigation Act of 2021 and created the California Sea Level Rise State and Regional Support Collaborative at the Ocean Protection Council to help coordinate and fund state efforts to prepare for sea level rise associated with climate change.

 - Focus on nature-based solutions.
 - Protect communities and natural resources, such as urban waterfront protection, ports, public infrastructure, and ecosystem protection.
 - Focus on investments that encourage regional collaboration, planning, and preparation. (Model after San Francisco Bay Conservation and Development Commission's efforts.)
 - Provide incentives for development of local funding strategies.

- **Combat Climate Change Impacts on Disadvantaged Communities.** According to the US Environmental Protection Agency (US EPA), the effects of climate change disproportionately fall on “underserved communities who are least able to prepare for, and recover from, heat waves, poor air quality, flooding, and other impacts.” The Senate proposes to appropriate a total of \$1 billion; \$200 million annually for five years to address the impacts of climate change for disadvantaged communities.
- **Biodiversity and Outdoor Access for All.** Last year’s budget agreement included funding for investments in nature-based solutions for: biodiversity protection, habitat corridors and connectivity, equitable access to nature, and urban greening. The Senate proposes to appropriate \$1 billion over multiple years for nature-based solutions, including:
 - \$500 million for 30x30 Goal (State goal of conserving 30 percent of state lands and coastal waters by 2030 to advance biodiversity and elevate the role of nature in the fight against climate change).
 - \$200 million for urban greening and urban forestry.
 - \$200 million for outdoor access through the Wildlife Conservation Board, state conservancies, State Coastal Conservancy, and other existing programs.
 - \$100 million for outdoor equity access grant program.
 - Use the project eligibility for 30x30 investments adopted in trailer bill language last year and add a science-based biodiversity requirement.

30x30 Goal. Use Existing Agencies and Program.

- Focus funding for 30x30 on existing programs that will help facilitate the protection and acquisition of land and waters.
 - Allocate funding to WCB and the state’s regional conservancies, which have a longstanding track record of effectively advancing protection and support the public use of natural resources.
- **Other Aspects of the Climate Package.** The package also includes the following:
 - ***Climate Equity Trust Fund.*** In recent years, California utility bills have typically been lower than most of the country. However, those trends are changing and California utility bills are inching higher. As stated in the CPUC 2021 report regarding utility costs and affordability, “California’s policy goals could result in rate and bill increases that would make other policy goals more difficult to achieve and could result in overall energy bills becoming unaffordable for some Californians.” The paper notes that wildfire mitigation and electrification are among the near-term needs that place upward pressure on rates and bills. The Senate’s Proposal seeks to establish the Climate Equity Trust Fund for the benefit of electricity customers and to promote affordable electricity rates. This fund may

support direct credits to ratepayer bills, direct rebates or incentives to market participants, and end-use customers, and among others.

- ***Achieve SB 100 Interim Goals.*** SB 100 established the 100 Percent Clean Energy Act of 2017 created the policy of planning to meet all of the state's retail electricity supply with a mix of Renewable Portfolio Standards- eligible and zero-carbon resources by December 31, 2045, for a total of 100 percent clean energy. The Senate's Proposal focuses on resources to help achieve interim goals of 90 percent of electricity sales to end-use customers is from renewable energy and zero-carbon resources by 2035 and 95 percent by 2040. Additionally, the Senate's Proposal prioritizes the transition to zero-carbon resources for state operations to meet 2030 carbon neutrality.
- ***High Road Labor Agreements for Clean Energy Projects.*** The Senate Proposal promotes high road labor agreements to include high quality jobs with good wages and benefits for clean energy projects.

The Plan proposes appropriations from a variety of sources, including the General Fund, special funds (e.g. Greenhouse Gas Reduction Fund), and federal funding.

Staff Comments. *Difference Between Senate Water Proposal and the Administration's Proposal for Voluntary Agreements (VAs).* VAs are designed to implement SWRCB's 2018 order and reduce litigation in a way that protects water agencies from additional cutbacks. It is in many ways outdated.

At best, the VA Memorandum of Understanding (MOU) will take effect in two or three years — if additional parties join AND SWRCB agrees to modify its regulatory actions.

The Senate Proposal does not provide guarantees to water agencies for diversions; it is not conditioned on any action by the Board. It just reduces water demand to reflect changed climate conditions.

The Senate Proposal recognizes that water demand exceeds supply now and will even more so in the future due to the new climate reality. It is designed to permanently retire significant amounts of water demand. This will help the state realign demand and supply.

Other elements of the proposal include:

- Increase drought resilient supply to urban areas by funding water recycling, efficiency, and stormwater capture.
- Improve the use of existing supplies through watershed-based measurement and investments to improve operational efficiencies.
- Funding of small system and disadvantaged community improvements and equity investments.
- Improve flood control for better stormwater capture and public safety.

The combination of the various elements of the Senate Water Proposal helps rebalance our water system to improve climate resilience.

Background.**ADDRESSING CLIMATE CHANGE AND CALIFORNIA: THE BASICS**

What is Climate Change? According to the US Environmental Protection Agency (US EPA), when energy from the sun reaches the Earth, the planet absorbs some of this energy and radiates the rest back to space as heat. The Earth's surface temperature depends on this balance between incoming and outgoing energy. Average conditions tend to remain stable unless the Earth experiences a force that shifts the energy balance. A shift in the energy balance causes the Earth's average temperature to become warmer or cooler, leading to a variety of other changes in the lower atmosphere, on land, and in the oceans.

A variety of physical and chemical changes can affect the global energy balance and force changes in the Earth's climate. Some of these changes are natural, while others are influenced by humans. These changes are measured by the amount of warming or cooling they can produce, which is called "radiative forcing." Changes that have a warming effect are called "positive" forcing, while changes that have a cooling effect are called "negative" forcing. When positive and negative forces are out of balance, the result is a change in the Earth's average surface temperature.

Changes in greenhouse gas (GHG) concentrations in the atmosphere affect radiative forcing. GHGs absorb energy that radiates upward from the Earth's surface, re-emitting heat to the lower atmosphere and warming the Earth's surface. Human activities (especially the burning of fossil fuels such as coal, oil, and gas) are a significant factor to increased concentrations of GHGs that can remain in the atmosphere for decades, centuries, or longer, so the corresponding warming effects will last for a long time.

The four main GHGs include:

- ***Carbon dioxide (CO₂)***. Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and also as a result of certain chemical reactions (e.g. manufacture of cement). CO₂ is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH₄). Methane is a potent GHG — that is 25-28 times greater than carbon dioxide — is the primary GHG driving climate change in California. It is the second largest source of global GHG emissions and is responsible for 20 percent of current global warming.

Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices, land use and by the decay of organic waste in municipal solid waste landfills. In 2017, methane accounted for nine percent of GHG emissions in California. In California, livestock enteric fermentation (i.e. digestive gas) and manure management, among other agricultural practices, contribute to a majority of statewide methane emissions. In addition, methane emissions can be challenging to control because they arise from these natural processes.

- ***Nitrous Oxide (N₂O)***. Nitrous oxide is emitted during agricultural land use, industrial activities, combustion of fossil fuels and solid waste, as well as during treatment of wastewater.
- ***Fluorinated Gases***. Hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride are synthetic, powerful GHGs that are emitted from a variety of industrial processes.

Fluorinated gases are sometimes used as substitutes for stratospheric ozone-depleting substances (e.g. chlorofluorocarbons, hydrochlorofluorocarbons, and halons). These gases are typically emitted in smaller quantities, but because they are potent GHGs, they are sometimes referred to as High Global Warming potential gases (“High GWP gases”). Fluorinated gases are used in a variety of applications, such as refrigeration, air conditioning systems, heat pump equipment, and as blowing agents for foams, aerosol propellants, and solvents.

Each gas’s effect on climate change depends on three main factors:

- ***How Much Is In the Atmosphere?*** Concentration, or abundance, is the amount of particular gas in the air. Larger emissions of GHGs lead to higher concentrations in the atmosphere. GHG concentrations are measured in parts per million, parts per billion, and even parts per trillion. One part per million is equivalent to one drop of water diluted into about 13 gallons of liquid (roughly the fuel tank of a compact car).
- ***How Long Do They Stay In the Atmosphere?*** Each of these gases can remain in the atmosphere for different amounts of time, ranging from a few years to thousands of years. All of these gases remain in the atmosphere long enough to become well mixed, meaning that the amount that is measured in the atmosphere is roughly the same all over the world, regardless of the source of the emissions.
- ***How Strongly Do They Impact the Atmosphere?*** Some gases are more effective than others at making the planet warmer and “thickening the Earth’s blanket.” For each GHG, a Global Warming Potential (GWP) has been calculated to reflect how long it remains in the atmosphere, on average, and how strongly it absorbs energy. Gases with a higher GWP absorb more energy, per pound, than gases with a lower GWP, and thus contribute more to warming the Earth.

According to the National Aeronautics and Space Administration, climate change involves many dimensions — science, economics, society, politics, and moral and ethical questions — and is a global problem, felt on local scales, that will be around for decades and centuries to come. For example, CO₂, the heat-trapping GHG that has driven recent global warming, lingers in the atmosphere for hundreds of years, and the planet (especially the oceans) takes a while to respond to warming. So even if emitting all GHGs stopped today, global warming and climate change will continue to affect future generations.

The amount of climate change is determined by how our emissions continue and how our climate system responds to those emissions. Despite increasing awareness of climate change, emissions of GHGs continue on a relentless rise.

Net-Zero GHG Emissions Target. More than 130 countries have now or are considering a target of reducing emissions to net zero by mid-century. Achieving net-zero GHG emissions — a state where GHG emissions either reach zero or are entirely offset by equivalent atmospheric GHG removal — is essential in all scenarios that would keep Earth’s average temperature within 1.5 degrees Celsius (C) of its historic average. Net-zero GHG emissions is often used interchangeably with “carbon neutrality,” however net-zero GHG emissions implies the inclusion of GHGs other than those that contain carbon, such as nitrous oxide, as defined by AB 32 (Nunez, Chapter 488, Statutes of 2006).

According to the United Nations Environment Programme (UNEP) 2020 Emissions Gap Report, which provides an annual update on global progress towards emissions reduction, the consensus is that, globally, we are not on track to meet that goal. However, the report does state that, “the growing number of countries committing to net-zero emissions goals by mid-century is the most significant climate policy

development of 2020. To remain feasible and credible, these commitments must be urgently translated into strong near-term policies and action.”

In California, carbon neutrality by 2045 was set as a goal for the state under Governor Brown’s Executive Order (EO) B-55-18. Prior to that, EO S-3-5 by Governor Schwarzenegger set the GHG reduction target of 80 percent below 1990 levels by 2050. A few additional sweeping targets have also been set to help achieve these goals including SB 100 (de Leon), Chapter 312, Statutes of 2018, to get California to 100 percent zero-carbon energy by 2045, EO N-79-20 to phase out sales of gas-powered cars in the state by 2035, and EO N-82-20 to conserve 30 percent of the state’s land and waters by 2030. Notably, besides SB 100 and the SB 32 target of 40 percent GHG reduction by 2030, all of these goals are established solely by executive order and thus, are not codified in statute.

Addressing Climate Change. There are two main categories of addressing climate change: mitigation and adaptation. Within these two categories are various ways to address climate change, including the following:

Mitigation. Mitigation means limiting the magnitude of future warming by preventing or reducing the emission of GHGs into the atmosphere. Mitigation is achieved either by:

Reducing the Sources of These Gases. The most commonly understood way of reducing GHG emissions is switching from fossil fuels to low-carbon energy sources, such as wind and solar power, and represents one of the major strategies for reducing GHG emissions into the atmosphere.

Carbon Capture and Sequestration (CCS). This is a tricky one. First, is it reducing or removing GHG emissions? CCS fits within the “mitigation” category and generally is considered a way of *reducing* emissions — rather than *removal* — because it is capturing the carbon before it enters the atmosphere.

Second, CCS can be a confusing term because people use it in two different ways depending on what they consider CCS to encompass: (1) “CCS” may be used in a broader sense that includes both natural carbon sinks and technological processes; or, (2) “CCS” may refer to the process of separating CO₂ from a point source, such as the flue of a gas-fired power plant or a cement plant, and putting it into long-term storage, usually by injecting CO₂ into a geological reservoir.

- The US Geological Services uses the term broadly, describing “carbon sequestration” as both natural and deliberate processes by which CO₂ is either removed from the atmosphere or diverted from emission sources and stored in ocean, terrestrial environments (vegetation, soils, and sediments), and geologic formations. In this broader sense of the term, carbon sequestration can either be terrestrial/biological or geologic.

On the other hand, US EPA uses a narrower definition of CCS meaning a set of technologies that can reduce CO₂ emissions from new and existing coal- and gas-fired power plants and large industrial sources. US EPA describes CCS as a three step process that includes:

- 1) Capture of CO₂ from power plants or industrial processes.
- 2) Transport of the captured and compressed CO₂ (usually in pipelines).
- 3) Underground injection and geologic sequestration (also referred to as storage) of the CO₂ into deep underground rock formations. These formations are often a mile or more beneath the surface

and consist of porous rock that holds the CO₂. Overlying these formations are impermeable, non-porous layers of rock that trap the CO₂ and prevent it from migrating upward.

The permanence of geologic sequestration depends on the effectiveness of several CO₂ trapping mechanisms. After CO₂ is injected underground, it will rise buoyantly until it is trapped beneath an impermeable barrier, or seal. In principle, this physical trapping mechanism, which is identical to the natural geologic trapping of oil and gas, can retain CO₂ for thousands to millions of years. Some of the injected CO₂ will eventually dissolve in groundwater, and some may be trapped in the form of carbonate minerals formed by chemical reactions with the surrounding rock. All of these processes are susceptible to change over time following CO₂ injection.

Scientists are studying the permanence of these trapping mechanisms and developing methods to determine the potential for geologically sequestered CO₂ to leak back to the atmosphere. The capacity for geologic carbon sequestration is constrained by the volume and distribution of potential storage sites.

To fully assess the potential for geologic carbon sequestration, economic costs and environmental risks must be taken into account. Infrastructure costs will depend on the locations suitable storage sites. Environmental risks may include seismic disturbances, deformation of the land surface, contamination of potable water supplies, and adverse effects on ecosystems and human health.

As noted above, CCS is generally considered by experts to be a CO₂ *reduction* strategy, not a CO₂ *removal* strategy, since it is only reducing CO₂ from anthropogenic sources that would have otherwise entered the atmosphere, rather than removing what was already there.

According to a report called *California's Energy Future — The View to 2050* by the California Council on Science and Technology and updated in 2015, any use of fossil fuels for electricity generation would need to be paired with CCS to meet the current 2050 GHG emissions target of 80 percent reduction. CCS is adoptable in California due to the existing geological storage from the state's history of fossil fuel extraction. However, according to a Lawrence Livermore National Lab (LLNL) report published in February 2021, no CCS could be scaled up at the pace needed due to the current regulatory framework for screening and authorizing projects. CARB has already adopted a CCS protocol under the Low Carbon Fuel Standard, including for out-of-state CCS projects. In addition to the economic and environmental concerns noted above, CCS remains controversial because it could prolong the life of fossil fuels and delay the transition to more sustainable fuels.

GHG Removal and Sequestration. Another way to address GHG emissions, is atmospheric GHG removal (also called “negative emissions” or “carbon dioxide removal”). For GHG removal options in California, LLNL produced a report in 2020 called *Getting to Neutral*, where LLNL determined that the state will need to remove on the order of 125 million tons of CO₂-equivalents per year from the atmosphere by 2045 to achieve carbon neutrality and remain in line with the current goal of 80 percent GHG emissions reduction by 2050. The report also concluded that “California can achieve this level of negative emissions at modest cost, using resources and jobs within the state, and with technology that is already demonstrated or mature.” The methods outlined in the report are capture and storage of carbon through nature-based solutions on natural and working lands, conversion of waste biomass to fuels and store CO₂, and direct air capture and CO₂ storage.

- *Nature-Based Solutions.* Nature-based climate solutions are actions that work with and enhance nature to help address societal challenges and includes terrestrial/biological sequestration. (These can sometimes result in decreasing emissions, but the main goal is more about long-term increase in carbon sequestration.). Nature-based solutions include actions such as directed land use

decisions that avoid conversion of open space or agricultural land for more intensive uses, landscape restoration, and alternative management for farms and forests. Actions can occur in natural ecosystems in urban, ex-urban, rural, wildland, or other environments. It is an umbrella concept to describe a range of ecosystem-related approaches that confer multiple benefits beyond emission reductions and carbon sequestration, such as landscape adaptation and resilience, improved air quality, biodiversity and habitat protection, improved water quality and quantity, and reduced impacts of extreme events such as floods or wildfires.

- Terrestrial/Biological Carbon Sequestration. Terrestrial sequestration (sometimes termed “biological sequestration”) is typically accomplished through forest and soil conservation practices that enhance the storage of carbon (such as restoring and establishing new forests, wetlands and grasslands) or reduce CO₂ emissions (such as reducing agricultural tillage and suppressing wildfires). These practices are implemented to meet a variety of land-management objectives. Existing terrestrial carbon storage is susceptible to disturbances such as fire, disease, and changes in climate and land use. The capacity of terrestrial ecosystems to sequester additional carbon is uncertain.

Healthy land can sequester and store carbon emissions, limit future carbon emissions into the atmosphere, protect people and nature from the impacts of climate change, and build resilience to future climate risks. Unhealthy lands have the opposite effect — they release more GHGs than they store, increase climate risks to people and nature, and are more vulnerable to future climate change impacts. Nature-based solutions depend on careful management of natural and working lands (NWL) to enhance biological removal of CO₂ from the atmosphere, reduce emissions of GHGs, and preserve existing carbon stores in NWL.

California’s NWL include rangelands, forests, woodlands, wetlands, grasslands, shrubland, farmland, riparian areas, and urban green space that cover more than 90 percent of the state. However, some sources show that California’s NWL are a net GHG source, losing more carbon than they are sequestering, with wildfire being the largest cause of carbon loss. A number of entities in California’s executive branch are developing policy and implementing programs to mitigate disturbances on NWL and protect these lands from conversion and to more intensive land uses. These can sometimes result in decreasing emissions, but the main goal is long-term increase in carbon sequestration.

- Technology-Based Solutions. CO₂ removal technologies are, for the most part, newer technologies that have not been scaled up or widely adapted in the state. Scientists are exploring new ways to remove and store carbon from the atmosphere using innovative technologies, and in some cases using it as a resource. Examples of technological carbon sequestration include:
 - Direct Air Capture (DAC). DAC is a process where specially designed machines are used to remove CO₂ from the ambient air (rather than a point source) and permanently store it underground or turn it into valuable products. This process is energy intensive and expensive, ranging from \$500-\$800 per ton of carbon removed. It is the most expensive CO₂ removal option, but it has nearly unlimited technical capacity, provided its energy needs can be met from a low-carbon source. Several commercial DAC plants are in operation or planning across Europe and the US, however it has not been deployed widely and is still a relatively new technology. While DAC can be effective, it is still too costly to implement on a mass scale.

- Engineered Molecules. Scientists are engineering molecules that can change shape by creating new kinds of compounds capable of singling out and capturing CO₂ from the air. The engineered molecules act as a filter, only attracting the element it was engineered to seek.
- Graphene Production. The use of CO₂ as a raw material to produce graphene, which is used to create screens for smart phones and other tech devices. Graphene production is limited to specific industries.

Enhancing the Storage of These Gases. Mitigation extends to the protection of natural carbon “sinks” like the forests and oceans. A carbon sink is something that absorbs more carbon from the atmosphere than it releases. For example, natural carbon sinks include in disturbed forests and soils, oceans, and photosynthesis of plants. New sinks can be created though, for example, forest regeneration.

Overall, mitigation may require the use of new technologies, clean energy sources, changes in people’s behavior, or making older technology more efficient. In short, mitigation is a human intervention that reduces the sources of GHG emissions and/or enhances the sinks.

Adaptation. Adaptation to climate change means taking actions to prepare for and adjust to both the current effects of climate change and the predicted impacts in the future. These adjustments may be ecological, social, or economic responses to actual or expected climate stimuli and their impacts. It refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change. Adaptation actions take many shapes and forms, depending on the community, business/organization, country, or region — there is no “one-size-fits-all” solution.

Examples of adaptation include building flood defenses, switching to drought-resistant crops, planning for heatwaves and higher temperatures, installing water-permeable pavements to better deal with floods and storm waters, and improving water storage and use. Adaptation is a key component of the long-term response to climate change to protect people, livelihoods, and ecosystems.

“Adaptation” is often accompanied by “resilience.” Adaptation actions and programs, which are designed to prepare for and respond to changing climate changes, taken together have a goal of building resilience. 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. Adaptation actions contribute to increasing resilience, which is a desired outcome or state of being” (*California’s Fourth Climate Change Assessment*, p. 15-16).

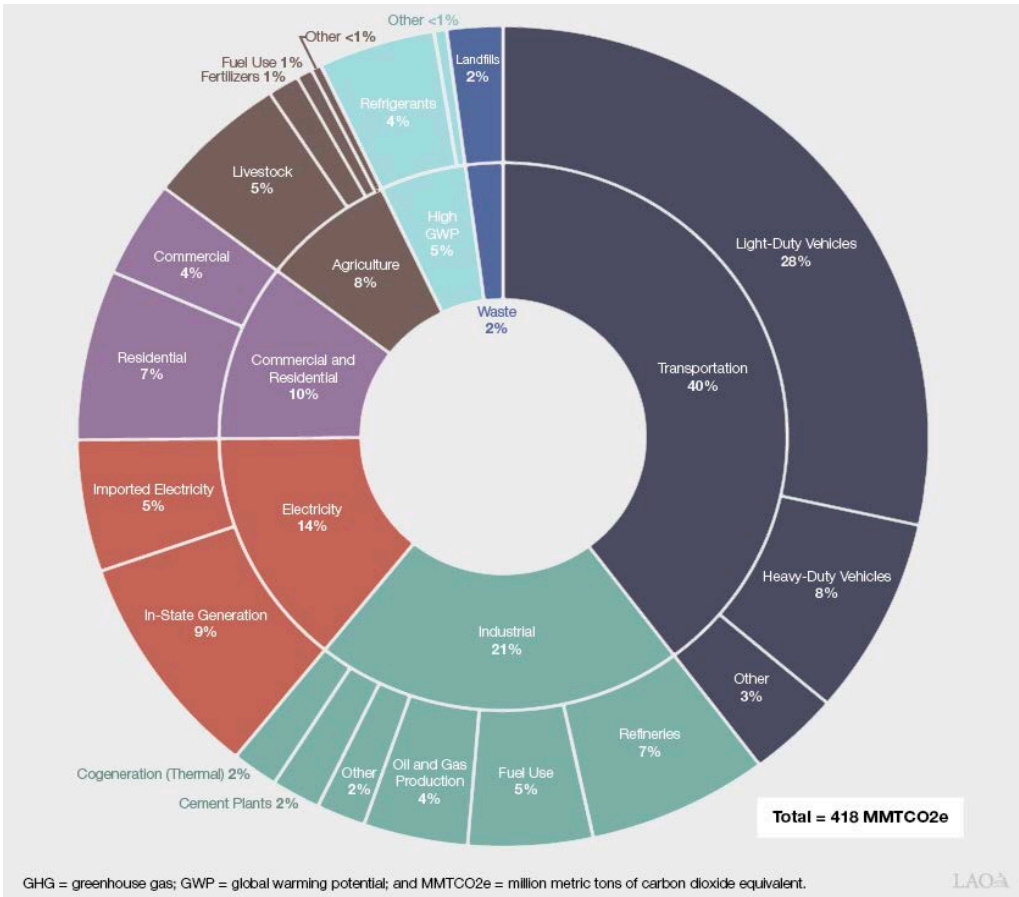
Climate Change and California

Sources of GHG Emissions in California. California is responsible for approximately one percent of all global GHG emissions. The main sources of state GHG emissions are:

- *Transportation* 40 percent
- *Industrial* 21
- *Electricity* 14
- *Commercial & Residential* 10
- *Agriculture* 8
- *High GWP* 5
- *Waste* 2

The chart below provides a further breakdown of the sources of GHG emissions in California:

Breakdown of Sources of GHG Emissions in California

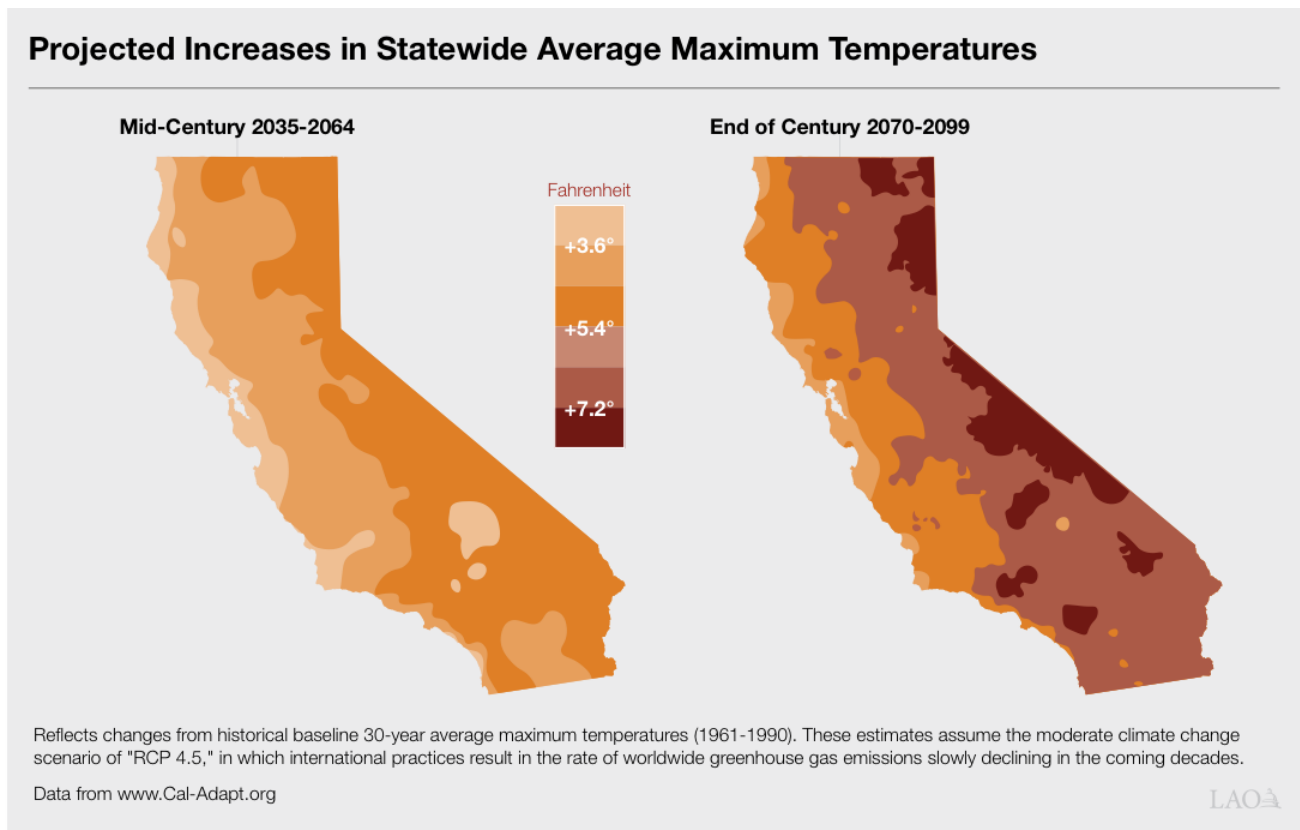


Source: Legislative Analyst's Office

Temperatures Rising in California. According to Scripps Institution of Oceanography, California has one of the world's most varied and volatile climates. Already subject to drought, wildfires, and extreme weather, California's environmental and social problems will be exacerbated by a warmer world. Temperatures will continue to rise in coming decades due to GHGs that are accumulating in the atmosphere from transportation, industry, and other human activity.

Average summer temperatures in California have risen by approximately 3 degrees Fahrenheit (F) since 1896, with more than half of the increase occurring since the early 1970s. If global GHG emissions continue at current rates, the state is likely to experience further warming by more than 2 degrees F by 2040, more than 4 degrees F by 2070, and by more than 6 degrees F by 2100. Some of the most impressive impacts of warming will be felt during short period heat events (e.g. days exceeding 106.6 degrees F). For example, if emissions continue at current rates, Fresno will likely experience 43 extreme heat days annually between 2050 and 2099; 10 times more than its yearly average between 1861 and 2005.

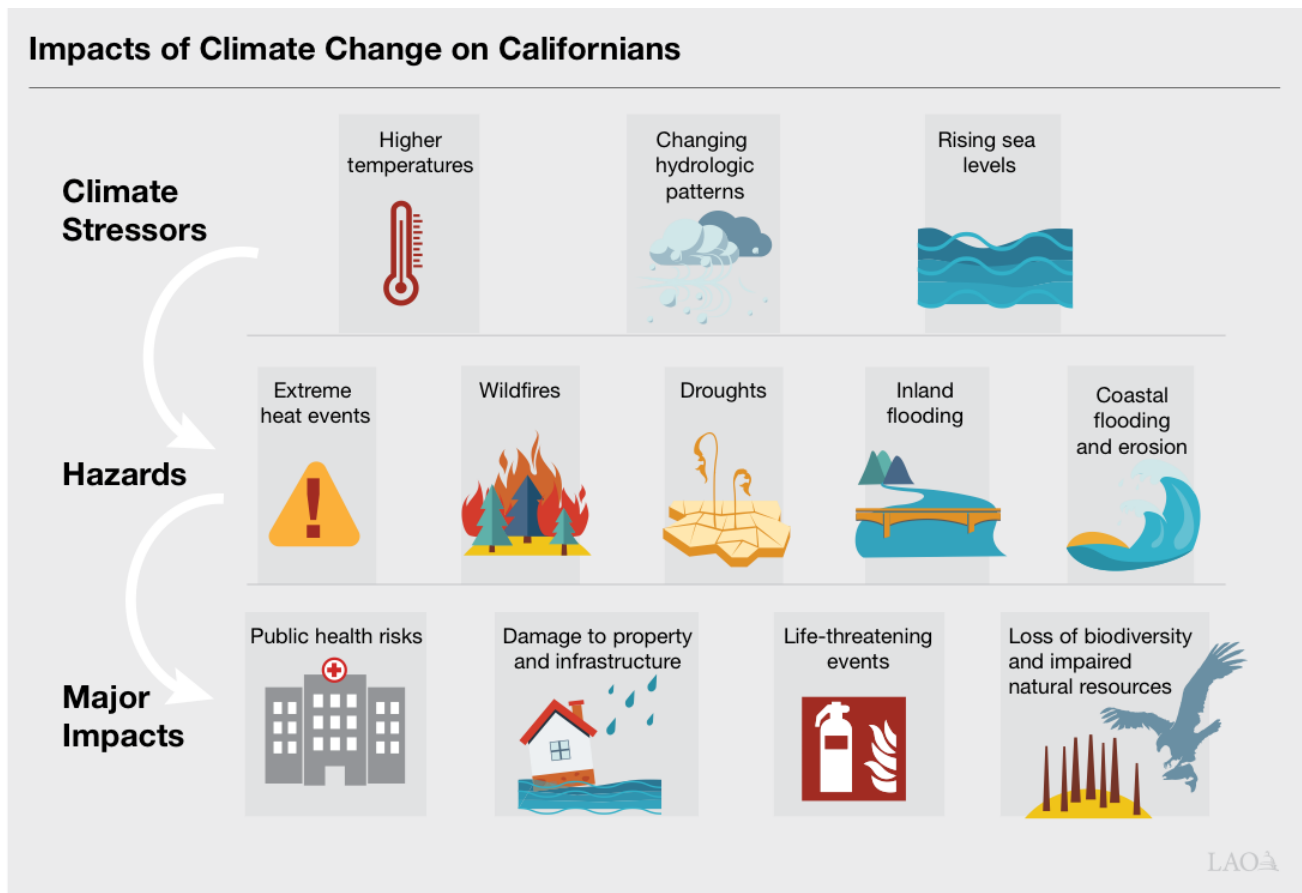
The figure below shows the projected increases in statewide average maximum temperatures across the state.



Source: LAO

California's unique landscape and coastal setting affect the patterns of warming. For example, Scripps climate researchers have detected a trend in California's heat waves, with particularly strong impacts along the coast. Specifically, they found that some heat waves have become increasingly more humid. These events have produced markedly warmer nighttime temperatures, a trend consistent with climate change projections. Moreover, the mid-summer heat waves are getting stronger in generally cooler coastal areas. This has particular importance for the millions of coastal dwelling Californians whose everyday lives are acclimated to moderate temperatures.

Climate Change is Projected to Have Significant Effects in California. According to LAO, scientific research predicts that climate change could have several consequential impacts as shown in the figure below:



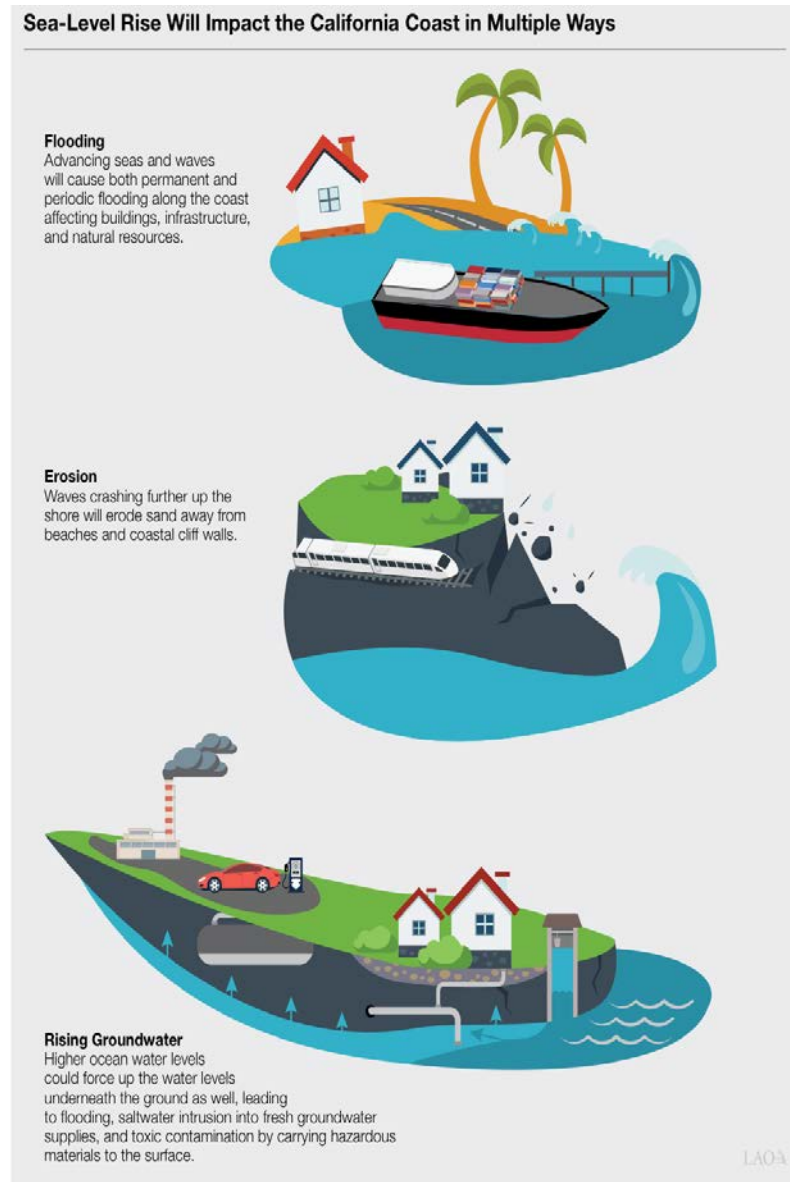
Source: LAO

The major impacts of climate change on this state include:

- Sea-Level Rise (SLR)
- Flooding
- Temperature Increases
- Drought
- Warming Oceans
- Wildfires

A description of each of these impacts is as follows:

- **Sea-Level Rise (SLR).** Recent estimates project that compared to 2000, sea levels along the California Coast south of Mendocino will rise between 1.5 inches and one foot by 2030 and between five inches and two feet by 2050.



Source: LAO

These changes would impact both human and natural resources along the coast, increasing the risk of flooding of buildings and infrastructure, salt water contaminating groundwater basins, and beaches eroding. The Intergovernmental Panel on Climate Change Oceans Report states that SLR will escalate and increase the frequency of extreme events such as storm surges, with significant impacts on coastal communities — events that used to occur just once per century in the past will occur every year by mid-century in many regions. In California, the infrastructure that is critical to the state's \$44 billion annual economy — including roads, rail lines, sewage treatment plants, ports, and power plants — is becoming more vulnerable to increased climate-related flooding.

- **Flooding.** Climate models predict more intense storm patterns, which would increase the risk of inland flooding. Floods cause significant risk to human life, as well as damage to roads, buildings, and other infrastructure.
- **Temperature Increases.** Extreme heat events are projected to worsen throughout the state. By midcentury, for example, the Central Valley is projected to experience high heat events that are two weeks longer than current patterns.

Changing temperatures could affect human health, agricultural production, and natural habitats. For example, warmer temperatures lead to the spread of mosquito-borne diseases like Zika and West Nile virus.

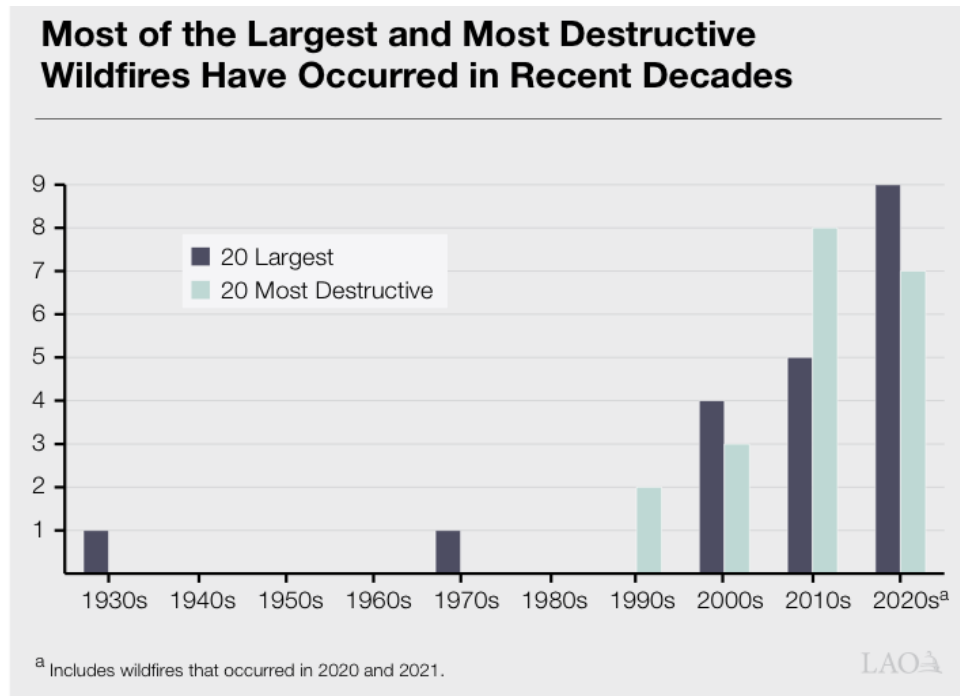
Heat waves are the natural disaster responsible for the most weather-related deaths in California and the World over the last 30 years, and scientists predict warmer temperatures will bring more of them. This is already happening and the trend has been clearly observed. The 2006 heat wave killed over 600 people, resulted in 16,000 emergency department visits, and led to nearly \$5.4 billion in damages. Research suggests that mortality risk for those 65 or older could increase ten-fold by the 2090s because of climate change. Scientists found that heat waves driven by Santa Ana winds can impact hospitalizations for heat-related illness in fall, spring, and winter. The findings stress that heat-related illnesses are not just limited to the summer in that area, and could be exacerbated by warming temperatures in the future year-round.

- **Drought.** Warmer temperatures would contribute to more frequent and intense droughts by leading to more precipitation falling as rain rather than snow, faster melting of winter snowpack, greater rates of evaporation, and drier soils. These conditions would decrease the amount of spring snowmelt runoff upon which the state historically has depended for its annual water supply, as well as increase the demand for irrigation water in both agricultural and urban settings.
- **Warming Oceans.** Evidence indicates that climate change is degrading the state's marine environment. In recent years, California's coastal environment has experienced a historic marine heat wave, record harmful algal bloom, fishery closures, and a significant loss of northern kelp forests.

The combination of warmer water temperatures, disease, invasive species, and the collapse of sea star populations statewide has placed California's North Coast kelp forest ecosystems in a state of emergency, with South Coast kelp struggling severely as well.

Ocean acidification and oxygen loss in the California Current is further impacting biomass production and species composition. Climate change overall exacerbates the effect of numerous other stressors on species populations, such as pollution and habitat destruction.

- **Wildfires.** Climate change is expected to make forests more susceptible to extreme wildfires. One study, for example, predicts that by 2100 the frequency of extreme wildfires burning over approximately 25,000 acres will increase by nearly 50 percent, and that the average area burned statewide will increase by 77 percent. Wildfires in California have become increasingly large and destructive over the past couple of decades.



Implementing effective strategies to increase protection and resilience against these wildfires is complex, in part due to the wide range of entities responsible for managing lands across the state, including local, state, and federal agencies; tribes; small private landowners; and timber harvest companies. Successfully implementing forest health and wildfire mitigation projects often require public and private entities to work together, particularly in order to complete larger, more complex and cross-jurisdictional projects than if they work independently.

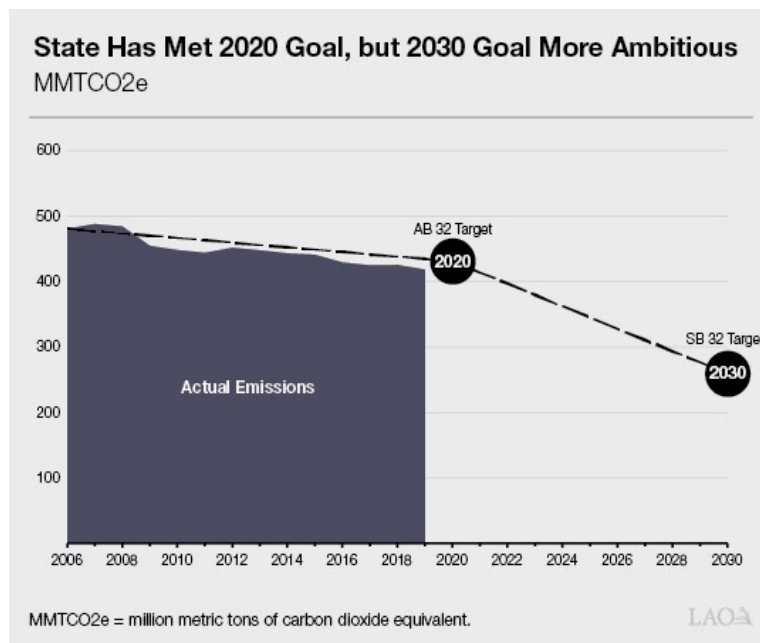
The Cost to California. Climate change comes with a huge price tag for every government, and California is no exception. For example, California 2018 wildfires, less than half the size of the 2020 conflagrations, cost \$148.5 billion in damages, with \$27.7 billion (19.9 percent) in capital losses, \$32.2 billion (22 percent) in health costs and \$88.6 billion (59 percent) in indirect losses with a majority of those far from the actual wildfire footprint. The cost of water and energy is predicted to increase significantly as well, especially in the Western United States. Some research suggests that under a business-as-usual scenario, between the years 2025 and 2100, estimates of the cost of providing water in the western states in the US will increase from \$200 billion to \$950 billion per year, nearly an estimated one percent of the US gross domestic product.

There is a greater human cost to climate change as well. In addition to capital losses, increased cost of resources and health costs, the impacts of climate change on mental health, food security, displacement and migration, and more are just coming into conversation and are still difficult to quantify.

California Goals and Overall Strategies to Address Climate Change

GHG Emissions Reduction Goals. According to LAO, AB 32 (Nunez), Chapter 488, Statutes of 2006 established the goal of limiting GHG emissions statewide to 1990 levels — 431 million metric tons of carbon dioxide equivalent (MMTCO₂e) — by 2020. (CO₂ is a standardized unit of measurement that is used to compare emissions from different GHGs — such as CO₂, methane, and nitrous oxide — based on their global warming potentials.). In 2016, SB 32 (Pavley), Chapter 249, Statutes of 2016, extended the limit to 40 percent below 1990 levels — to 259 MMTCO₂e — by 2030.

As shown in the figure below, emissions have decreased since AB 32 was enacted and were below the 2020 target in 2019. However, the rate of reductions needed to reach the SB 32 target are much greater.



Source: Legislative Analyst's Office

AB 32 Climate Change Scoping Plan. Pursuant to AB 32, CARB developed, and periodically updates, California's Climate Change Scoping Plan, which lays out the state's strategy for meeting its emission reduction goals, including targets and standards for clean energy, clean transportation, energy efficiency, land use and agriculture, industry, and other key sectors.

The Scoping Plan was first approved by CARB in 2008 and must be updated at least every five years. Since 2008, there have been two updates to the Scoping Plan. Each of plans have included a suite of policies to help the state achieve its GHG targets, in large part leveraging existing programs that have the primary goal of reducing harmful air pollution.

The state achieved its 2020 GHG emissions reductions target of returning to 1990 levels four years earlier than mandated by AB 32. The state is currently implementing strategies in the 2017 Scoping Plan Update to further reduce its GHG emissions by 40 percent below 1990 levels by 2030. The anticipated 2022 Scoping Plan Update will assess progress towards achieving the SB 32 2030 target and lay out a path to achieve carbon neutrality by 2045.

Climate change programs in the state reduce GHG emissions that come from many sectors of the economy. These programs include regulations, market programs, and incentives that are intended to transform areas of transportation, industry, fuels, and others.

2021 State Climate Adaptation Strategy. The Administration's draft Strategy was released in October 2021 and outlines key climate resilience priorities, includes specific and measurable steps, and serves as a framework for action across sectors and regions. The Strategy describes the state's policy approach to addressing the impacts of climate change, but not intended to be a commitment to any particular project or program. Priorities outlined in the draft Strategy include:

- Strengthen protections for climate vulnerable communities.
- Bolster public health and safety in light of increasing climate risks.
- Build a climate resilient economy.
- Accelerate nature-based climate solutions and strengthen climate resilience of natural systems.
- Make decisions based on best available climate science.
- Partner and collaborate to leverage resources.

State Actions Addressing Climate Change

Over the years, the state has implemented a broad portfolio of actions to address climate change. The following are a sampling of state measures in a variety of sectors and are broken down by sectors:

- Nature-Based Solutions
- Forest and Wildfire
- Water
- Oceans and Coasts
- Biodiversity
- Energy
- Transportation
- Agriculture
- Multi-Sector Measures

Nature-Based Climate Change Solutions

As noted above, nature-based climate change solutions consist of actions to reduce or sequester GHG emissions in natural ecosystems. They can take place in a variety of environments, such as urban, exurban (a semirural region beyond the suburbs where not many houses are built and where rich people often live), rural, and wildlands.

Natural and Working Landscapes. Natural and working lands are the foundation of California's nature-based climate change solution sector. Healthy land can sequester and store carbon emissions, limit future carbon emissions into the atmosphere, protect people and nature from the impacts of climate change, and build resilience to future climate risks. Unhealthy lands have the opposite effect — they release more

GHGs than they store, increase climate risks to people and nature, and are more vulnerable to future climate change impacts.

Natural and working lands cover approximately 90 percent of the state's 105 million acres, including:

- Forests — lands with greater than or equal to 10 percent canopy cover comprised of live trees, such as oak woodlands, riparian forests, and conifer forests.
- Shrublands & Chaparral — lands with greater than or equal to 10 percent canopy cover comprised of shrubs or chaparral. These lands are dominated by woody plants such as manzanita, sage brush, and huckleberry oak.
- Developed Lands — lands developed for human use, such as urban, suburban, and rural communities; urban forests; and physical infrastructure.
- Wetlands — lands saturated by water for all or portions of a year, such as coastal wetlands, floodplains, peat lands, mountain meadow wetlands, and vernal pools.
- Seagrasses & Seaweeds — seagrasses are marine flowering plants, such as eelgrass and surf grass. Seaweeds are algae, such as kelp.
- Croplands — lands with annual or perennial crops and fallow land, such as perennial orchards and irrigated annual crops.
- Grasslands — lands with less than 10 percent tree canopy cover that are dominated by grasses or herbaceous vegetation.
- Sparsely Vegetated Lands — lands characterized primarily by low levels of vegetation, including deserts, beaches, and areas covered by ice, snow, and bare rock.

According to the UNEP, “By working with nature, we have the potential to reduce emissions by more than a third of what is needed by 2030 without nature, we will not be able to achieve 1.5 degrees Celsius or net-zero emissions by 2050, nor will we achieve the Sustainable Development Goals.”

Natural and Working Lands (NWL) Climate Smart Strategy. The purpose of the NWL Climate Smart Strategy is to align relevant existing state efforts under one cohesive strategy and identify land management actions that help protect climate-vulnerable communities, achieve carbon neutrality, improve public health and safety, and expand economic opportunity. The draft *Natural and Working Lands Climate Strategy* was released on October 11, 2021. This Strategy will inform the 2021 State Adaptation Strategy and the 2022 Scoping Plan. This Strategy does the following:

- Defines California's eight natural and working landscapes. (*See above.*)
- Describes how these lands can deliver on the state's climate goals.
- Highlights priority nature-based climate solutions to address the climate change.
- Explores opportunities for regional climate smart land management.

- Identifies options to track nature-based climate action and measure progress.
- Outlines approximately 200 opportunities to scale climate smart land management across regions and sectors in the state.

30x30 Strategy. In October 2020, Governor Newsom signed the Nature-Based Solutions Executive Order (EO) N-82-20, emphasizing the role of natural and working lands in the fight against climate change and advancing biodiversity conservation. As part of the EO, the state commits to the goal of conserving 30 percent of lands and coastal waters by 2030. In December 2021, the draft 30x30 strategy was released and does the following:

- Describes the key objectives and core commitments that are a part of California's 30x30 conservation framework.
- Defines conservation for the purpose of the 30x30 initiative and establishes a current baseline of conserved areas.
- Outlines strategic actions necessary to achieve the 30x30 target.
- Introduces CA Nature, a suite of publicly available applications to identify conservation opportunities and track progress.

Forest and Wildfire

Wildfire and Forest Resilience Action Plan. Climate change increases the frequency and severity of catastrophic wildfires. There is strong consensus that climate change extends the periods of wildfire risk and enhances the likelihood of fires. Land use and forest management practices are also contributing factors but cannot fully explain the magnitude of wildfires in recent years. In January 2021, the Governor's Forest Management Task Force released *California's Wildfire and Forest Resilience Action Plan*. The Plan is intended to accelerate efforts to:

- Restore the health and resilience of forests, grasslands, and natural places.
- Improve the fire safety of our communities.
- Sustain the economic vitality of rural forested areas.

To meet these goals, the Plan lays out that the following will need to be achieved:

- Scale-up forest management to meet the state and federal one million-acre annual restoration target by 2025.
- Significantly expand the use of prescribed fire across the state.
- Restore areas burned by catastrophic fire.
- Support communities, neighborhoods, and residents in increasing their resilience to wildfire.

- Utilize a statewide network of regional plans to ensure coordinated, comprehensive action across the state.
- Develop a comprehensive program to assist private forest landowners, who own more than 40 percent of the state's forested lands.
- Create economic opportunities for the use of forest materials that store carbon, reduce emissions, and contribute to sustainable local economies.
- Improve and align forest management regulations. Spur innovation and better measure progress.

Forest Health Program. The Forest Health Program works to address the risk of California's forests from extreme disturbance events including catastrophic wildfires, drought, and pest mortality. The purpose of the program is to conserve forests and improve forest health by significantly increasing fuels reduction, fire reintroduction, treatment of degraded areas and conservation of threatened forests with landscape-scale projects developed and led by regionally-based efforts.

Regional Forest Fire Capacity Program (RFFC). Created in 2018, the Department of Conservation (DOC) provides non-competitive block grants to state conservancies, resource conservation districts, and other entities to facilitate regional coordination for forest health and wildfire resilience.

Urban and Community Forestry Grant Program. Through this program, CalFire works to optimize the benefits of trees and related vegetation through multiple-objective projects. The mission of the program is to lead the effort to advance the development of sustainable urban and community forests in the state.

Urban Greening Grant Program. CNRA's Urban Greening Grant Program funds projects that reduce GHG emissions by sequestering carbon, decreasing energy consumption, and reducing vehicle miles traveled, while also transforming the built environment into places that are sustainable, enjoyable, and effective in creating healthy and vibrant communities.

California Conservation Corps' (CCC's) Targeted Conservation Programs and Grant Programs. Under its Targeted Conservation Program, CCC operates three programs dedicated to forest health and resiliency. Through these programs, corpsmembers reduce overgrown and dying trees, plant trees, and build fire breaks. The CCC also operates the Watersheds Program, which has the mission to conserve, restore, and enhance anadromous watersheds. Also, CCC administers several programs and grants to conserve, restore, and enhance natural resources, including watershed protection and wildland fire prevention projects.

California Tahoe Conservancy's Climate Change Adaptation Program. The Conservancy's strategic plan includes a goal to foster Basin-wide climate change adaptation and sustainable communities. To achieve this goal, the Conservancy focuses on four areas: developing the Lake Tahoe Climate Adaptation Action Portfolio, providing grants to support climate change adaptation, adapting Conservancy programs and land management to changing climate conditions, and engaging partners and collaborating with scientists.

Water

California Water Resilience Portfolio. According to CNRA, climate change projections indicate a future characterized by more intense droughts and floods and winter storms that bring less snow and more rain. We cannot exactly predict how the interplay of higher average temperatures, increased variability in precipitation, depletion of soil moisture, and accelerated evapotranspiration will affect the hydrological cycle. To cope with a likely future of “wetter wets” and “drier dries,” California water managers must plan and invest in strategies that include more efficient use of water, recycling of water, additional water storage, additional conveyance to facilitate recharge of aquifers, improved forecasting tools, better data about river flows and water consumption, and restoration of upper watersheds.

The Water Resilience Portfolio was released in July 2020, which is the Administration’s blueprint for equipping the state to cope with more extreme droughts, floods, and rising temperatures, while addressing long-standing challenges that include declining fish populations, over-reliance on groundwater, and lack of safe drinking water in many communities. Goals and actions are organized in four categories:

- ***Maintain and Diversify Water Supplies.*** State government will continue to help regions reduce reliance on any one water source and diversify supplies to enable flexibility as conditions change.
- ***Protect and Enhance Natural Ecosystems.*** Restore the environmental health of river systems in order to sustain fish and wildlife. This entails effective standard setting, continued investments, and more adaptive, holistic environmental management.
- ***Build Connections.*** The state aims to improve physical infrastructure to store, move, and share water more flexibly and integrate water management through shared use of science, data, and technology.
- ***Be Prepared.*** Each region must prepare for new threats, including flashier floods, deeper droughts, and hotter temperatures. State guidance will enable preparation, protective actions, and adaptation.

The portfolio includes 142 separate actions to be taken by state agencies to support local efforts to maintain and diversify water supplies, protect and enhance natural systems, build connections (whether human, physical, or digital), and prepare for future risks.

Sierra Nevada Conservancy’s Improvement Program (WIP). A watershed is a land area that channels rainfall and snowmelt to creeks, streams, and rivers, and eventually to outflow points such as reservoirs, bays, and the ocean. While some watersheds are relatively small, others encompass thousands of square miles and may contain streams, rivers, lakes, reservoirs, and underlying groundwater that are hundreds of miles inland.

The Sierra Nevada Region is the primary source of water for the California Water Project and the federal Central Valley Project. Together, these two systems deliver water to two-thirds of California’s population (such as the Bay Area, Sacramento, and Los Angeles regions) and provide irrigation water for more than one-third of the agricultural land (such as farms and ranches in the Sacramento and San Joaquin Valleys) in the state.

WIP is a large-scale, coordinated, and collaborative program to restore the health of the state’s primary watershed and create resilient Sierra Nevada communities through increased investments and policy

changes that increase the pace and scale of restoration. It is recognized by state policy and planning documents as a model program for addressing the growing challenges facing the Sierra Nevada Region in a changing climate. WIP actions include:

- Restoring Sierra forests and watersheds to a healthier state
- Improving the quantity and quality of water throughout the year
- Reducing GHG emissions and stabilize carbon storage
- Improving local socio-economic conditions and public safety
- Improving habitat for wildlife, fish, and plant species
- Reducing the risk of large, damaging wildfires
- Preserving working landscapes
- Protecting air quality

DWR's Climate Change Program. DWR's climate change program performs a range of activities to support climate change analysis and adaptation planning by local and regional water managers, fund climate monitoring and research, and develop water sector policies and management practices. DWR is also developing its own comprehensive Climate Action Plan.

DOC's Climate Change Initiatives. DOC administers several programs, including the Watershed Coordinator Program, which enables local governments and non-profits to develop plans and projects to improve watershed health, to achieve targeted state and local and natural resources climate resiliency goals including forest health and groundwater sustainability.

Urban Flood Protection Grant Program. CNRA's Urban Flood Protection Grant Program funds multibenefit projects in urban areas to address flooding. Projects include stormwater capture and reuse, planning and implementation of low-impact development, restoration of urban streams and watersheds, and increasing permeable surfaces to help reduce flooding.

Oceans and Coasts

Strategic Plan to Protect California's Coast and Ocean 2020-2025. Climate change impacts the oceans and coasts in alarming ways. The International Panel on Climate Change recently found that coastal ecosystems are under stress from ocean warming, intensified marine heat waves, ocean acidification, loss of oxygen, and sea level rise, and that impacts to species, biodiversity, and ecosystem services are already being observed. The Ocean Protection Council (OPC) released the *Strategic Plan to Protect California's Coast and Ocean 2020-2025*, which is meant to provide a roadmap to address these challenges and includes the following goals:

- Safeguard coastal and marine ecosystems and communities in the face of climate change.
- Advance equity across ocean and coastal policies and actions.
- Enhance coastal and marine biodiversity.
- Support ocean health through a sustainable blue economy.

OPC's Climate Change Program. OPC's Climate Change Program seeks to prepare for and reduce harmful impacts of climate change on ocean and coastal resources by encouraging adaptation and mitigation, and engaging decision makers at all levels of government. OPC helps the state address the

impacts of SLR and ocean acidification through advancing science, monitoring change, developing adaptation strategies and policy guidance, and engaging in national and international partnerships.

State Coastal Conservancy's (SCC's) Climate Change Initiatives. SCC has a range of measures including: helping communities assess their vulnerability to SLR and create adaptation plans to counter threats of SLR; helping to plan, design, and implement living shorelines that use oyster beds, wetlands, dunes, and other natural habitats to buffer the impacts of rising seas and increased storm events while providing multiple benefits; helping rangeland and agricultural lands adapt to changing climates including grazing operations, grassland restoration, and water and soil conservation projects such as water catchments and storage design; and working to protect natural and working lands that remove and capture these gases in photosynthesis. Additionally, SCC adopted a Climate Change Policy that informs all aspects of its work and amended its Project Selection Criteria to ensure that all SCC projects are designed with climate change in mind.

San Francisco Bay Conservation and Development Commission's (BCDC's) Climate Change Initiatives. BCDC facilitates resilience through its permitting program, which requires developments to address SLR impacts in their design. Additionally, BCDC's Adapting to Rising Tides (ART) Program provides support, guidance, tools, and information to help agencies and organizations address sea level rise.

San Joaquin Delta Conservancy Carbon Management Program. The Delta Conservancy incentivizes landowners to convert to practices that reduce carbon emissions and land subsidence that result from oxidation of highly organic peat soils in the Delta. A voluntary market protocol was approved by the American Carbon Registry in 2017 for restoration of coastal and delta wetlands in the state. In 2020, the program completed the first verification and certification of wetland carbon credits anywhere in the world.

Biodiversity

California Biodiversity Collaborative. The Collaborative is a new platform to enable active stewardship of the state's biodiversity by providing a forum to coordinate public and private programs and investments; to share information and build on best practices; and to facilitate partnerships and increase understanding.

Department of Fish and Wildlife's (DFW's) Climate Change Initiatives. DFW's Science Institute's Climate Change Program evaluates climate risks to biodiversity and supports integration of climate science and adaptation into the department's programs and activities. DFW is addressing climate change in species and habitat management, land management, conservation planning, and scientific endeavors. DFW's Wetland Restoration for GHG Reduction Program addresses both climate change adaptation and mitigation by restoring or enhancing wetlands and watershed ecosystems.

Wildlife Conservation Board's (WCB's) Climate Adaptation and Resiliency Program. This program funds projects that provide climate adaptation and resilience on natural and working lands. These projects must be consistent with the state's climate adaptation strategy, contribute to the goals of AB 32, support WCB's Strategic Plan, and help fulfill WCB's mission to protect, restore, and enhance the state's natural resources for wildlife and for public use and enjoyment.

Energy

Renewable Portfolio Standard (RPS). Established in 2002, the RPS requires electricity providers (i.e., utilities, cooperatives, and community choice aggregators) to ensure that renewable energy constitutes a specified minimum portion of their electric load. Investor-owned electric utilities must serve 33 percent of their electric load by 2020, and 60 percent of their electric load by 2030, with renewable energy. Beyond this, SB 100 (de Leon), Chapter 312, Statutes of 2018, further increased the RPS target to 100 percent by 2045. CPUC and CEC jointly implement the RPS program. The goals of the program include:

- Displacing fossil fuel use
- Building new renewable power plants
- Reducing GHG emissions
- Ensuring reliable operation of the electrical grid
- Promoting customer affordability through stable customer rates

Overall, retail sellers either met or exceeded the 33 percent interim RPS target by December 31, 2020.

Green Building Standard. The Green Building Standard requires commercial and residential buildings to meet minimum energy efficiency standards. In California, commercial and residential account for approximately a quarter of the state's GHG emissions through their use of electric and natural gas. In January 2008, the California Building Standards Commission (BSC) approved the California Green Building Standards Code, also referred to as CALGreen, which went into effect in August 2009.

CALGreen is designed to improve public health, safety, and welfare through the use of sustainable construction and building concepts that reduce environmental impacts or create environmental benefits. The code applies to the planning, design, operation, construction, use, and occupancy of newly-constructed buildings in the state. CALGreen is enforced by local agencies.

CEC develops building energy efficiency standards, which are a core element of CALGreen. CEC's building energy efficiency standards, often referred to as Title 24, are designed to require cost-effective measures such as building insulation, efficient lighting and appliances, and air system improvements to reduce building energy use and save energy and maintenance costs over the life of a building. CEC updates the standards every three years.

Low-Carbon Fuel Standard (LCFS). Emissions from the transportation sector is responsible for 50 percent of GHG emissions, 80 percent of nitrogen oxide emissions, and 95 percent of particulate matter emissions in the state.

LCFS is designed to reduce the carbon intensity (CI) of transportation fuels (e.g. diesel and gasoline) by 20 percent by 2030 while providing a range of low-carbon and renewable alternatives. The program aims to reduce California's overall dependency on petroleum and improve statewide air quality. Substitutes for conventional gasoline include ethanol, electricity, and hydrogen fuel. Substitutes for conventional diesel include biodiesel, renewable diesel, fossil fuel natural gas, and renewable natural gas (biomethane).

CARB implements and enforces California's LCFS program, which includes the following elements:

- *Scope.* The LCFS aims to reduce the carbon intensity of transportation fuels sold in-state by 20 percent through 2030 through annually decreasing targets. CI is a measure of the GHG emissions released by the full lifecycle of a fuel, including production, transportation, and consumption.

- *Regulated Parties.* Petroleum fuel importers, refiners, and wholesalers in California are required to reduce CI across their product lines under the LCFS. Other entities, such as biofuel refiners and electric and natural gas suppliers, can opt into the program to generate credits.
- *CI Target.* Benchmarks for gasoline and diesel fuel carbon intensity are calculated each calendar year with the goal of reducing carbon intensities over time.
- *LCFS Compliance.* The program achieves the goal to reduce statewide CI of fuels by getting a standard that conventional fuel suppliers, such as refineries, must meet each year. To ensure that the CI of its overall fuel pool meets the annual LCFS target, a regulated entity must lower the CI of its fuel pool (by substituting cleaner fuels) and/or purchase LCFS credits from other regulated entities. Compliance is demonstrated through a system of credits and deficits. Suppliers of conventional fuels such as gasoline and diesel (“regulated parties” must comply by obtaining enough credits to cover their deficits each year. Other entities (“opt-in parties”) can voluntarily participate in the program by supplying lower CI substitute fuels to generate credits to sell to regulated parties.
- *Credits.* The gap between the CI target and the intensity of certain fuel types dictates the LCFS credit deficit or generation. For example, a diesel refiner will need to purchase LCFS credits to compensate for CI of the fuel above the target, whereas a biofuel refiner will generate and then sell LCFS credits for intensity of the fuel below the target. Credits are valued as dollars per metric ton of avoided carbon dioxide equivalent emissions. The LCFS Program allows producers and importers to generate, acquire, transfer, bank, borrow, and trade credits. LCFS credits do not expire and any surplus of LCFS credits can be banked for future compliance.
- *Use of Revenues.* Electric distribution utilities that generate LCFS credits are required to sell the credits and use the revenue to benefit current or future electric vehicle customers through rebate programs. For all other credit-generating entities, the revenues are an incentive to participate in the LCFS and develop more low-carbon fuels.

Since going into effect, LCFS has increased the statewide use of low-carbon fuels. For example, the share of alternative fuels in transportation grew from 6.1 percent to 8.5 percent between 2011 and 2017. The majority of this share comes from blended ethanol, biodiesel, and renewable diesel fuels.

Advanced Clean Cars Program. This program combines the control of smog-causing (criteria) pollutants and GHG emissions into a single coordinated package of two distinct efforts: (1) Low-Emission Vehicle (LEV) regulation for criteria and GHG emissions; and (2) Zero-Emission Vehicle (ZEV) regulation. The goal of the program is to guide the development of environmentally advanced cars that will continue to deliver the performance, utility, and safety that car owners have come to expect.

When CARB adopted Advanced Clean Cars in 2012, the Board committed to conducting a comprehensive midterm review of three elements of the program: (1) the ZEV regulation, (2) the one milligram per mile particulate matter standard, and (3) the light-duty vehicle GHG standards for 2022 and later model years. At its March 2017, CARB concluded the following:

- Adopted GHG standards remain appropriate for 2022 through 2025 model years.
- Continue with existing technology-forcing ZEV requirements to develop the market.

- Direct staff to immediately begin rule development for 2026 and subsequent model years.
- Continue and expand complementary policies to help support an expanding ZEV market.
- The particulate matter standard is feasible but further action is needed to ensure robust control.

Following CARB's direction to begin development of standards for model years after 2025, Advanced Clean Cars II (ACC II) is currently in process of establishing the next set of LEV and ZEV requirements to contribute to meeting federal ambient air quality ozone standards and California's carbon neutrality targets. The main objectives of ACC II are: (1) Maximize criteria and GHG emission reductions through increased stringency and real-world reductions; and, (2) Accelerate the transition to ZEVs through both increased stringency of requirements and associated actions to support wide-scale adoption and use. A rulemaking package is anticipated to be presented to the Board in June 2022.

LEV Regulation for Criteria Pollutants and GHG Emissions. CARB adopted the first LEV regulations in 1990, requiring manufacturers to produce light- and medium-duty vehicles that emitted fewer criteria pollutants like carbon monoxide and nitrogen oxides. In 2004, CARB added the first vehicle GHG emission limitations. Finally, as part of the Advanced Clean Cars Program, the LEV regulations were amended in 2012 to strengthen the program by including increasingly stringent criteria pollutant and GHG emission standards for new passenger vehicles through the 2025 model year. In July 2019, CARB reached an agreement with major automakers to proactively adopt a modified version of the GHG standards despite conflict with the US EPA over their validity under the Clean Air Act.

In order for a manufacturer to certify that a vehicle for sale in California meets LEV standards, it must follow stringent emission testing procedures and requirements, and receive verification from CARB. CARB estimates that cars will emit 75 percent less in criteria pollutants and 40 percent less in GHG emissions in 2025 compared to 2012 model year vehicles.

California's GHG regulations are projected to reduce GHG emissions from new vehicles by approximately 40 percent (from 2012 model year vehicles) in 2025. Studies indicate that they are technologically feasible and will likely save consumers money over the life of the vehicle because lower fuel use accompanies reductions of GHGs. Technologies to achieve the new standards include engine and emission control advancements, wider application of advanced hybrid technology, and greater use of stronger and lighter materials.

ZEV Regulation. The ZEV regulation requires manufacturers to increase the number of vehicles available for sale that do not emit any exhaust, including battery electric, hydrogen fuel cell, and plug-in hybrid electric vehicles in order to achieve the state's long-term emissions reduction goals. These vehicle technologies include full battery-electric, hydrogen fuel cell, and plug-in hybrid electric vehicles. Manufacturers are required to produce for sale in the state a certain percentage of ZEVs and plug-in hybrid electric vehicles in a given year. Every vehicle receives credits based on the number of miles the vehicle can travel powered by non-emitting sources. A manufacturer can bank credits to use for compliance in future years or trade or sell credits. CARB oversees the compliance process and posts annual credit information on its website. Updated estimates show about eight percent of California new vehicle sales in 2025 will need to be ZEVs and plug-in hybrids to comply with the requirements.

CEC's Climate Change Initiatives. CEC manages numerous programs and efforts that help the state meet its climate goals by increasing energy efficiency and conservation, as well as advancing renewable energy and low-carbon technologies.

California Geologic Energy Management Division's (CalGEM's) Carbon Capture and Sequestration Program. CalGEM facilitates the state's Carbon Capture and Sequestration Program, which involves the capture, transport, and long-term storage of CO₂ in geological reservoirs deep underground that would otherwise be released to the atmosphere.

Transportation

Transportation Infrastructure Spending. SB 1 (Beall), Chapter 5, Statutes of 2017, increased the state's gasoline tax by \$0.12 per gallon, raising over \$5 billion annually for transportation projects, including improvements in efficiency and emission reduction.

Sustainable Transportation Planning. SB 375 (Steinberg), Chapter 728, Statutes of 2008 and SB 743 (Steinberg), Chapter 386, Statutes of 2013, set regional GHG emission reduction targets for passenger vehicles and required agencies to assess and mitigate the vehicle miles traveled (VMT) impacts of new developments. SB 150 (Allen), Chapter 646, Statutes of 2017, required a CARB report on the progress and implementation of SB 375, and found that the state was falling well short of meeting those goals.

Agriculture

Climate-Smart Agriculture (CSA). Agriculture is California's fifth largest emitting sector, producing eight percent of the state's GHG emissions; and accounts for most of California's nitrous oxide (N₂O) emissions, primarily from fertilizer and manure added to soil, which have global warming potential up to 298 times that of CO₂.

CSA involves agricultural practices such as mulching, crop rotation, and integrated crop-livestock management that increase resiliency and productivity of agriculture in the face of climate change while reducing associated emissions. "CSA" can be used interchangeably with terms like regenerative agriculture or agroecology. While similar in strategy and terminology, regenerative agriculture differs from CSA in that it focuses on replacing conventional farming practices that degrade soil with ones that regenerate soil's capacity to sequester carbon and nitrogen. CSA comprises management practices that:

- Improve farming efficiencies, including water and energy use.
- Promote sustainable land practices.
- Increase soil health and carbon sequestered in soil.

In order to address emissions from the agricultural sector, the state has developed a suite of CSA programs to reduce GHG emissions and provide multiple benefits that improve the health and adaptability of farms, ecosystems, and communities. CSA programs include:

- ***Alternative Manure Management Program (AMMP).*** CDFA administers AMMP provides financial assistance for dairy and other livestock producers for the implementation of improved manure management practices, including storage and field application, that avoid the GHG emissions generated by transitional anaerobic digester treatments.
- ***Sustainable Agricultural Lands Conservation Program (SALCP).*** On behalf of the Strategic Growth Council, the Department of Conservation administers SALCP, which protects agricultural lands that are at risk of conversion to other uses. The program funds agricultural

conservation easements to maintain farmland in addition to funding local government grants to improve farmland conservation.

- ***State Water Efficiency and Enhancement Program (SWEET)***. CDFA administers SWEET, which provides grants to implement irrigation systems for agriculture that reduce GHGs, reduce on-farm energy use, and conserve water.
- ***Healthy Soils Program (HSP)***. CDFA administers HSP, which is a collaboration of state agencies, to promote and develop healthy soils that can boost productivity and longevity as well as sequester carbon. HSP actions include protecting and restoring soil organic matter, identifying financing opportunities, funding research to support healthy soils, increasing the generation and use of compost, and promoting interagency coordination.

DOC's Climate Change Initiatives. DOC administers several programs related to land conservation. In terms of agriculture, DOC programs include: the Sustainable Agriculture Lands Conservation (SALC) Program, which facilitates the purchase of agricultural easements, development of agricultural land strategy plans, and other mechanisms that result in GHG reductions and a more resilient agricultural sector; and the Working Lands and Riparian Corridors Program, which funds watershed restoration projects and conservation projects on agricultural lands.

Multi-Sector Measures

California Climate Investments (CCI) Cap-and-Trade Program. CCI is the umbrella initiative for programs funded by revenues from Cap-and-Trade auctions. These funds are used to reduce pollution that causes climate change and other benefits that include improving public health, quality of life, and economic opportunity in the state's most burdened communities. CCI projects include affordable housing, renewable energy, public transportation, zero-emission vehicles, environmental restoration, more sustainable agriculture, recycling, and more.

At least 35 percent of these investments are made in disadvantaged communities and low-income communities and households. SB 535 (de Leon), Chapter 830, Statutes of 2012, directed at least a quarter of the proceeds go to projects that provide a benefit to disadvantaged communities and at least 10 percent of the funds go to projects located within those communities. AB 1550 (Gomez), Chapter 369, Statutes of 2016, modified the investment minimums to disadvantaged communities and increased the percentage of funds directed — at least 25 percent — that should go to projects within and for the benefit of disadvantaged communities and at least an additional 10 percent to go for low-income households or communities.

The five main steps for CCI program administration include:

- ***Fund Generation.*** The Cap-and-Trade Program includes an auction in which polluting entities purchase allowances from the state. Proceeds are deposited into GGRF.
- ***Fund Appropriation.*** The Legislature and Governor authorize agencies to make expenditures from GGRF for specified programs and periods of time.
- ***Fund Allocation.*** Once agencies are appropriated funds from GGRF, the agencies allocate these funds to one or more selected funding recipients within the funded programs.

- *Fund Awards.* Agencies award funds to recipients. At this stage, GHG emissions reductions are estimated as well since project designs are known.
- *Fund Implementation.* The funding recipient receives funds and develops projects over a set timeframe.

The Cap-and-Trade regulation establishes a declining limit on major sources of GHG emissions throughout the state, and is intended to create economic incentive for investment in cleaner, more efficient technologies. The program applies to emissions that cover approximately 80 percent of the state's GHG emissions. ARB creates allowances equal to the total amount of permissible emissions (i.e., the "cap"). One allowance equals one metric ton of carbon dioxide equivalent emissions (using the 100-year global warming potential). Each year, fewer allowances are created and the annual cap declines. An increasing annual auction (or floor) prices for allowances and the reduction in annual allowances is intended to create a steady and sustained carbon price signal to prompt action to reduce GHG emissions.

Revenue from quarterly Cap-and-Trade auctions are deposited in the Greenhouse Gas Reduction Fund (GGRF), and the funds are allocated to various programs, which are mostly climate-related.

Short-Lived Climate Pollutants (SLCPs). SLCPs include GHGs such as methane, hydrofluorocarbons, and anthropogenic black carbon. SLCPs are powerful climate forcers that have relatively short atmospheric lifetimes. For example, the atmospheric lifetime of methane is about 12 years. For comparison, CO₂ has a variable atmospheric lifetime since some portion of excess CO₂ is absorbed quickly by the oceans and terrestrial vegetation, while some remains in the atmosphere for thousands of years. Despite the comparatively short period of time that it remains in the atmosphere, methane is a potent GHG that is 25 times more effective at trapping heat in the atmosphere than CO₂ over a 100-year period.

SB 1383 (Lara), Chapter 395, Statutes of 2016, directed CARB to approve and begin implementing a comprehensive strategy to reduce SLCPs in the state to achieve, from 2013 levels, a 40 percent reduction in methane, a 40 percent reduction in hydrofluorocarbon gases, and a 50 percent reduction in anthropogenic black carbon, by 2030. Measures designed to achieve these reductions are organized across three primary sectors:

Agriculture. California dairy and livestock are responsible for over half of the state's methane emissions and are the largest source of dairy-related methane in the country. In response to SB 1383, CARB, along with other state agencies, convened a Dairy and Livestock GHG Emission Working Group to provide recommendations to inform actions related to reducing methane emissions from agricultural operations and incentivizing funding and research.

Oil and Gas. In 2017, CARB issued the GHG Emission Standards for Crude Oil and Natural Gas Facilities, or the Oil and Gas Regulation, after a three-year workshop and proposal process. The regulations are designed to reduce emissions from oil and gas production, processing, storage, and transmission compressor stations. The regulation requires oil and gas producers to address both fugitive and vented emissions of methane from new and existing oil and gas facilities through emission control plans, leak testing, and repairs. CARB estimates compliance will reduce methane emissions by over one million tons annually. In addition, natural gas storage facility operators (whose product is primarily methane) must conduct continuous leak monitoring and prevention.

Organics/Landfills. AB 341 (Chesbro), Chapter 476, Statutes of 2011, directed CalRecycle to examine existing efforts and propose strategies to reduce the amount of solid waste going to landfills by 75 percent

by 2020. SB 1383 (Lara) established a statewide target of reducing the amount of organic waste sent to landfills 75 percent below 2014 levels by 2025. CalRecycle must achieve recovery of at least 20 percent food waste by 2025. The state's infrastructure currently diverts about half of the waste stream, but is not large enough to meet the state's climate goals and handle the large amount of potentially recyclable materials collected by local governments and the solid waste industry.

Indicators of Climate Change in California. The Office of Environmental Health Hazard Assessment (OEHHA) researches and presents indicators in periodic reports describing how the state's climate is changing and how these changes are affecting the state. Indicators are scientifically-based measurements that track trends in various aspects of climate change. The 2018 report compiled 36 indicators grouped into four categories: human-influenced drivers of climate change, such as GHG emissions; changes in the state's climate; impacts of climate change on physical systems, such as oceans and snowpack; and the impacts of climate change on biological systems — humans, vegetation, and wildlife.

Adaptation Clearinghouse. This website provides users with a consolidated searchable database of California-specific resources for local, regional, and statewide climate adaptation planning and decision-making.

Adaptation Planning Guide. California Office of Emergency Services (Cal OES) works with state partners to regularly update this guide designed to support local governments, regional organizations, and climate collaborative groups to integrate best practices and current science into their adaptation efforts.

THE BUDGET ACT OF 2021

The 2021 Budget Act included \$15 billion (\$13.1 billion General Fund) allocated over three years to support a suite of natural resources packages, including: climate resilience; wildfire and forest prevention and resilience; water and drought; zero-emission vehicles; sustainable agriculture; and circular economy (recycling). Collectively, these packages (some of which cover multiple years) are intended to protect against, and address, climate change impacts.

Climate Resilience Package. The 2021 Budget Act included \$3.69 billion General Fund over three years to support investments that address the state's multi-faceted climate risks. These funds will build community resilience and capacity where resources are most needed. Investments will support multi-benefit and nature-based solutions, which includes funding to support climate change impacts on fish and wildlife, habitat restoration, and activities that accelerate climate smart management of California's natural and working lands. Funds are also included to address the impacts of extreme heat, build ocean and coastal resilience, and support California's fifth climate assessment.

The amount of spending for each of main categories are:

- \$800 million Extreme Heat
- \$1.371 billion Multi-Benefit and Nature Based Solutions
- \$612 million Building Ocean and Coastal Resilience
- \$819 million Community Resilience
- \$87 million Other

The chart below details allocations for the Climate Resilience Package:

Climate Resilience Package (Dollars in Millions)						
Investment Category	Department	Program	2021-22	2022-23	2023-24	Total
Extreme Heat	California Natural Resources Agency	Urban Greening	\$50	\$100	\$100	\$250
	Department of Community Services and Development	Low Income Weatherization	\$0	\$25	\$25	\$50
	Strategic Growth Council	Community Resilience Centers/Extreme Heat and Community Resilience Program	\$0	\$50	\$150	\$200
	Various	Extreme Heat Set Aside	\$0	\$150	\$150	\$300
Multi-Benefit and Nature Based Solutions	Department of Fish and Wildlife	Climate Change Impacts on Wildlife	\$15	\$35	\$0	\$50
	Department of Water Resources	Habitat Restoration	\$0	\$125	\$75	\$200
	Wildlife Conservation Board	Protect Fish and Wildlife from Changing Conditions	\$31	\$222	\$100	\$353
	Various	Multi-Benefit and Nature Based Solutions Set Aside	\$0	\$593	\$175	\$768
Building Ocean and Coastal Resilience	Ocean Protection Council	Ocean Protection	\$0	\$50	\$50	\$100
	State Coastal Conservancy	Coastal Protection and Adaptation	\$0	\$350	\$150	\$500
	Department of Parks and Recreation	State Parks Sea Level Rise Adaptation Strategy	\$12	\$0	\$0	\$12
Community Resilience	Strategic Growth Council	Transformative Climate Communities	\$115	\$165	\$140	\$420
		Regional Climate Collaboratives	\$10	\$10	\$0	\$20
	Office of Planning and Research	Climate Adaptation & Resilience Planning Grants	\$10	\$10	\$5	\$25
		Vulnerable Communities Platform and CalAdapt Mapping	\$5	\$0	\$0	\$5
		Regional Climate Resilience	\$25	\$125	\$100	\$250
	Various	Conservancy Funding	\$60	\$0	\$0	\$60
	Cal Volunteers	California Climate Action Corps	\$5	\$5	\$5	\$14
	California Environmental Protection Agency	Environmental Justice Initiative	\$10	\$10	\$5	\$25
Other	Department of Conservation	Biomass to Hydrogen/Biofuels Pilot	\$0	\$50	\$0	\$50
	Various	Fifth Climate Assessment	\$22	\$0	\$0	\$22
	Air Resources Board	Fluorinated Gas Reduction Incentive Program	\$0	\$15	\$0	\$15
Total			\$369	\$2,090	\$1,230	\$3,689

Source: Department of Finance

According to the LAO, the budget package adopted in September 2021 appropriated \$369 million for climate change related activities in 2021-22, all from the General Fund. Moreover, the budget agreement included intent to provide additional General Fund for climate resilience activities in the coming years—\$2.1 billion in 2022-23 and \$1.2 billion in 2023-24—for a three-year total of \$3.7 billion. As shown in the figure, funds will support multiple activities across several departments and respond to various climate change impacts, including extreme heat, sea-level rise along the coast, and threats to the state’s biodiversity. While certain activities will be undertaken by state departments—such as DFW’s efforts to protect the state’s fish and wildlife from changing conditions—the majority of the funds will be allocated through grant programs to local governments or nongovernmental organizations. Because several of the funded activities represent new programs or initiatives, in many cases, budget trailer legislation included language guiding specifically how funds should be prioritized and allocated.

Wildfire Prevention and Resilience Package. In April 2021, the Legislature passed and the Governor signed an early action package totaling \$536 million (\$411 General Fund; \$125 million GGRF) for a broad set of investments that support a statewide strategy on forest health and fire prevention. This funding was designed to start critical projects before the upcoming fire season and launch several new programs.

In September 2021, an additional \$988 million was allocated for 2021-22 (\$758 million General Fund; \$230 million GGRF) for wildfire prevention and resilience projects and programs.

In total, the amount of spending for each of the main categories were:

- \$825 million Resilient Forests and Landscapes
- \$494 million Wildfire Fuel Breaks
- \$47 million Community Hardening
- \$82 million Science-Based Management
- \$76 million Economic Development of the Forest Sector

The table below details the Wildfire Prevention and Resilience Package approved last session:

Wildfire Resilience Expenditure Plan (Dollars in Millions)					
Investment Category	Department	Program	Early Action 2020-21	2021-22	Total
Resilient Forests and Landscapes	CAL FIRE	Forest Health Program	\$155	\$160	\$315
		Forest Improvement Program for Small Landowners	\$10	\$40	\$50
		Forest Legacy & Demonstration Forests	\$8	\$19	\$27
		Urban Forestry	\$10	\$20	\$30
		Tribal Engagement	\$1	\$19	\$20
	State Parks, Fish & Wildlife	Stewardship of State-Owned Land	\$30	\$145	\$175
	Conservancies	Project Implementation in High-Risk Regions	\$69	\$139	\$208
Wildfire Fuel Breaks	CAL FIRE	CAL FIRE Unit Fire Prevention Projects	\$10	\$40	\$50
		Fire Prevention Grants	\$123	\$120	\$243
		Prescribed Fire & Hand Crews & Contract Counties	\$15	\$49	\$64
	California Conservation Corps	Fuel Reduction Crews & Residential Centers	\$0	\$27	\$27
	Department of Conservation	Regional Forest Capacity	\$50	\$60	\$110
Community Hardening	CalOES & CAL FIRE	Home Hardening	\$25	\$0	\$25
	CAL FIRE	Defensible Space Inspectors	\$2	\$13	\$15
	CAL FIRE & University of California	Land Use Planning & Public Education Outreach	\$0	\$7	\$7
Science-Based Management	CAL FIRE	California Vegetation Treatment Program	\$3	\$20	\$23
	Natural Resources Agency	LiDAR Remote Sensing	\$0	\$25	\$25
	CAL FIRE	Interagency Forest Data Hub	\$0	\$10	\$10
	CAL FIRE	Prescribed Fire Liability Pilot	\$0	\$20	\$20
	Air Resources Board and Water Board	Prescribed Fire Permitting	\$0	\$4	\$4
Economic Development of the Forest Sector	I Bank	Climate Catalyst Fund	\$16	\$33	\$49
	CAL FIRE	Workforce Training	\$6	\$18	\$24
	Office of Planning & Research	Market Development	\$3	\$0	\$3
Total			\$536	\$988	\$1,524

Source: Department of Finance

According to the LAO:

- ***Most Funding Was One-Time From General Fund.*** Of the total funding for the package, \$411 million is from the General Fund and \$125 million is from GGRF. The amounts from the General Fund are provided on a one-time basis, though in many cases departments anticipate expending the funds over multiple years. The amounts from GGRF are intended to bring total GGRF spending on forest health and prescribed fire activities to \$200 million annually, consistent with requirements in SB 901 (Dodd), Chapter 626, Statutes of 2018. (The 2020-21 Budget Act provided less than the statutory direction because of uncertainty about the amount of GGRF revenues at the time the budget act was adopted in June 2020.)
- ***Early Action Intended to Provide Immediate Funding in Advance of Fire Season.*** The adoption of the early action package was intended to enable departments to start work immediately on projects rather than waiting until the passage of the 2021-22 budget in June. By starting work immediately, the Administration anticipated that projects would be in place roughly one fire season sooner than they would have been otherwise. For example, some projects funded by this package were implemented in time to reduce the risk of catastrophic wildfires in fall 2021—peak fire season in California—rather than being completed in 2022 if they had been funded as part of the 2021-22 budget.
- ***Package Included Language Expediting Projects and Directing Fire Prevention Funding.*** The package included language intended to support certain departments' efforts to complete projects quickly by expediting their contracting processes, such as through exempting them from competitive bidding requirements. Additionally, the package included language intended to ensure that fire prevention grants are distributed to fire prone areas throughout the state regardless of vegetation type. Specifically, the language requires CalFire to prioritize fire prevention projects in locations of high fire risk and that would protect large numbers of structures and people relative to the size of the grant. The language also required CalFire to do additional outreach to areas of the state that historically have had low application rates for these grants.

Water and Drought Resilience Package. The 2021 Budget Act included \$5.2 billion (\$4.7 billion General Fund) over three years to support immediate drought response and long-term water resilience. This included funding to support drought response: drinking water, wastewater, and water supply reliability; water recycling and groundwater clean up; flood management; restoration of natural areas and ecosystems; Salton Sea; groundwater sustainability; water conveyance; and water and habitat improvement for environmental flows. These investments provide immediate drought support and address long-term water resilience.

The amount of spending for each of the main categories are:

- \$ 3.309 billion Drinking Water, Water Supply and Reliability, Flood
- \$ 815 million Immediate Drought Relief
- \$ 1.033 billion Nature Based Solutions

The chart below provides more detail about the Water and Drought Resilience Package:

Water Resilience Package (Dollars in Millions)						
Investment Category	Department	Program	2021-22	2022-23	2023-24	Total
Drinking Water, Water Supply and Reliability, Flood	State Water Resources Control Board	Drinking Water/Wastewater Infrastructure	\$1,300	\$0	\$0	\$1,300
		PFA's Support	\$30	\$30	\$20	\$100
		Water Recycling/Groundwater Cleanup	\$200	\$100	\$100	\$400
	Department of Water Resources	Saltion Sea	\$40	\$100	\$80	\$220
		SGMA Implementation	\$180	\$60	\$60	\$300
		Water Conveyance	\$100	\$100	\$0	\$200
		Flood	\$313	\$237	\$88	\$638
		Watershed Climate Studies	\$25	\$0	\$0	\$25
		Aqueduct Solar Panel Pilot Study	\$20	\$0	\$0	\$20
	Department of Food and Agriculture	State Water Efficiency and Enhancement Program	\$50	\$50	\$0	\$100
	Natural Resources Agency	Clear Lake Rehabilitation	\$5.7	\$0.0	\$0.0	\$6
	Various	Data, Research, and Communications	\$127	\$0	\$0	\$127
	Various	Drought Technical Assistance, Emergency Water Supplies, & Control Section	\$52	\$0	\$0	\$52
Immediate Drought Support	Department of Conservation	Multi-benefit Land Repurposing	\$50	\$0	\$0	\$50
	Department of Water Resources	Small Water Supplies Drought Relief & Urban Water Management Grants	\$500	\$0	\$0	\$500
	Various	Drought Permitting, Compliance, and Enforcement	\$36	\$3.5	\$3.5	\$43
	Department of Fish and Wildlife	Drought fisheries and Wildlife Support	\$43	\$0	\$0	\$43
	Natural Resources Agency	Water Resilience Projects	\$165	\$100	\$180	\$445
Nature Based Solutions	Wildlife Conservation Board	Wildlife Corridors/Fish Passage	\$65	\$40	\$0	\$105
		Stream flow Enhancement Program	\$100	\$150	\$0	\$250
	State Water Resources Control Board	Border Rivers	\$20	\$0	\$0	\$20
	Various	Restoration of Natural Areas and Ecosystems	\$130.1	\$24.4	\$8.9	\$163
	Various	Urban Streams	\$30	\$20	\$0	\$50
Total			\$3,582	\$1,035	\$541	\$5,157

Source: Department of Finance

Statutory Provisions for Immediate Drought Response Spending. According to the LAO, budget trailer legislation, AB 148 (Committee on Budget), Chapter 115, Statutes of 2021, included provisions applicable to drought response expenditures. In particular, the language allowed implementing departments to make direct expenditures to provide immediate relief for drought conditions—rather than being subject to typical statutory requirements for competitive grant or bid processes—if the Governor has declared a drought state of emergency or SWRCB determines that urgent actions are needed to respond to drought impacts on drinking water, public safety, or fish and wildlife. Such expenditures could include providing emergency drinking water supplies, drilling new wells, or rescuing and relocating at-risk fish and wildlife. The legislation also allowed departments to provide local grantees that have demonstrated cash flow problems with advance payments for up to 25 percent of the costs of their emergency drought response projects in lieu of relying completely on the traditional cost reimbursement process.

Sustainable Agriculture Package. The 2021 Budget Act included the Sustainable Agriculture Package totaling \$1.1 billion, \$683 million of which is appropriated in 2021-22 as shown in the chart below:

Sustainable Agriculture
(Dollars in Millions)

Investment Category	Program	2021-22	2022-23	Total
Healthy, Resilient, and Equitable Food Systems	California Farm to School Incubator Grant Program	\$30	\$30	\$60
	Farm to Community Food Hubs Program	\$15	\$0	\$15
	California Nutrition Incentive Program	\$10	\$10	\$20
	Healthy Refrigeration Grant Program	\$10	\$10	\$20
	Senior Farmers Market Nutrition Program	\$0.5	\$0.0	\$0.5
	Urban Agriculture Program	\$12	\$0	\$12
Climate Smart Agriculture for Sustainability and Resiliency	Agricultural Diesel Engine Replacement and Upgrades	\$213	\$150	\$363
	Healthy Soils	\$75	\$85	\$160
	Sustainable California Grown Cannabis Pilot Program	\$9	\$0	\$9
	Livestock Methane Reduction	\$32	\$48	\$80
	Pollinator Habitat Program	\$15	\$15	\$30
	Technical Assistance and Conservation Management Plans	\$17	\$22	\$39
	Transition to Safer, Sustainable Pest Management	\$9.8	\$0	\$10
	Incentives for Alternatives to Agricultural Burning in the San Joaquin Valley	\$180	\$0	\$180
	Research in GHG Reduction	\$5	\$5	\$10
	Invasive Species Council	\$5	\$5	\$10
	Climate Catalyst Fund	\$0	\$25	\$25
Economic Recovery & High-Road Job Growth	Technical Assistance Program for Underserved Farmers	\$5.4	\$5	\$10
	Impact Assessment and Alignment of Regulatory Reporting Requirements for Agriculture	\$4	\$2	\$6
	Fresno-Merced Future of Food Innovation Initiative	\$30	\$0	\$30
	New and Beginning Farmer Training and Farm Manager Apprenticeships Program	\$5	\$5	\$10
	Canine Blood Bank	\$1	\$0	\$1
Total		\$683	\$417	\$1,100

Source: Department of Finance

Of the 2021-22 appropriation, \$247 million was allocated in SB 129 (Skinner), Chapter 69, Statutes of 2021, and the remainder was allocated in SB 170 (Skinner), Chapter 240, Statutes of 2021. In total, these investments support three primary categories of funding: (1) healthy, resilient and equitable food systems; (2) climate smart agriculture for sustainability and resiliency; and, (3) economic recovery and high-road job growth.

Circular Economy Package. The 2021 Budget Act included \$205 million in 2021-22, which was part of a two-year, total package of \$270 million (\$130 million General Fund) to support a “circular economy” that recognizes waste as a resource, with the purpose of shifting the state’s focus to a more resilient and renewable economy. These funds will support implementation of goals to reduce short-lived climate pollutants, including advancing organic waste infrastructure, edible food recovery, and composting opportunities; and support other non-organic recycling opportunities. The figure below details the total allocations in the Circular Economy Package:

Circular Economy Package
(Dollars in Millions)

Investment Category	Department	Program	2021-22	2022-23	Total
Organic Waste Infrastructure and Implementation	Cal Recycle	Edible Food Recovery	\$3	\$2	\$5
		Composting Opportunities	\$5	\$0	\$5
		Organic Infrastructure Grants	\$90	\$15	\$105
		Co-Digestion Capacity	\$10	\$10	\$20
		SB 1383 Local Jurisdiction Implementation Grants	\$60	\$0	\$60
Non-Organic Waste	Cal Recycle	Recycling Feasibility Grants	\$2	\$13	\$15
		Recycling Market Development Zone Loan Program	\$25	\$25	\$50
		Quality Incentive Payments for PET Thermoform-Free Beverage Container Loads	\$10	\$0	\$10
		Total	\$205	\$65	\$270

Source: Department of Finance

The two main categories of this package are: (1) organic waste; and (2) non-organic waste. Organic waste investments for 2021-22 total \$168 million. Investments to address non-organic waste issues total \$37 million for 2021-22. All funding for this package is through CalRecycle.

According to LAO, notable new programs or program expansions include:

- **Recycling Market Development Zone (RMDZ) Loan Program.** The budget plan provided \$50 million from the General Fund over two years to the existing RMDZ loan program, which provides loans to recycling businesses that prevent, reduce, or recycle recovered waste materials. Budget-related legislation made changes to the RMDZ loan program to allow eligibility for certain facilities that are outside of RMDZs.
- **Co-Digestion at Waste Water Treatment Plants.** The budget plan included \$20 million from the General Fund over two years to expand an existing GHG reduction grant program to include food waste co-digestion projects at waste water treatment plants.
- **Quality Incentive Payments for Sorting Plastic Containers.** The 2021-22 budget included \$10 million from the Beverage Container Recycling Fund (BCRF) to provide quality incentive payments to curbside recycling programs for the sorting and separation of clean polyethylene terephthalate plastic containers.
- **Circular Economy Development.** The budget plan included a total of \$15 million from the General Fund over two years for a new program that will provide grants to entities that are in the

research, development, feasibility assessment, and pilot phases of new recycling technologies and projects.

- ***SB 1383 Implementation.*** The budget provides five permanent positions and \$782,000 from the Cost of Implementation Account (increasing to nine positions and \$1.4 million ongoing) to implement organic waste reduction regulations pursuant to SB 1383. CalRecycle also plans to redirect 38 existing positions from its local assistance and market development programs to instead focus on compliance and enforcement of SB 1383 regulations.

Zero-Emission Vehicles (ZEVs) Package. The 2021 Budget included \$2.7 billion for a variety of programs related to ZEVs. This was intended to be the first year of a three-year, \$3.9 billion investment. Of the total in 2021-22, \$2.9 billion comes from the General Fund, with the remainder coming from federal funds and special funds. In most cases, the budget provided flexibility to spend the funds over the next few years.

Zero-Emission Vehicle Investment Package (dollars in millions)

ZEV Investment	2021-22	2022-23	2023-24	Total
Clean Trucks, Buses, and Offroad Equipment	\$ 500.00	\$ -	\$ -	\$ 500.0
Clean Cars 4 All	\$ 150.00	\$ 125.0	\$ 125.0	\$ 400.0
CVRP	\$ 525.0	\$ -	\$ -	\$ 525.0
Drayage Trucks	\$ 160.0	\$ 160.0	\$ 150.0	\$ 470.0
Drayage Pilot Projects	\$ 65.0	\$ -	\$ -	\$ 65.0
Transit Buses	\$ 100.0	\$ 100.0	\$ 90.0	\$ 290.0
School Buses	\$ 150.0	\$ 150.0	\$ 150.0	\$ 450.0
ZEV Infrastructure	\$ 500.0	\$ -	\$ -	\$ 500.0
ZEV Manufacturing Grants	\$ 125.00	\$ 125.0	\$ -	\$ 250.0
ZEV Transit Funding	\$ 407.00	\$ -	\$ -	\$ 407.0
Near Zero Truck replacement	\$ 50.00	\$ -	\$ -	\$ 50.0
TOTAL	\$ 2,732.00	\$ 660.0	\$ 515.0	\$ 3,907.0

Significant investments include:

- *Heavy-Duty ZEVs and Supporting Infrastructure.* \$2 billion one-time General Fund and special funds over three years for heavy-duty ZEVs.
- *Light-Duty ZEV Adoption and Transportation Equity.* \$1.2 billion one-time General Fund and special funds over three years to invest in consumer adoption of ZEVs and in clean mobility for disadvantaged and low-income communities.
- *Zero-Emission Rail and Transit Equipment Purchases and Infrastructure.* \$407 million one-time General Fund and special funds to demonstrate and purchase or lease state-of-the-art, clean bus and rail equipment and infrastructure that eliminate fossil fuel emissions and increase intercity rail and intercity bus frequencies.

- *ZEV and Infrastructure Manufacturing.* \$250 million General Fund one-time over two years for manufacturing and supply chain grants to expand California's nation leading ZEV manufacturing footprint, administered through the Clean Transportation Program.
- *ZEV Market Development Strategy Implementation.* \$5 million in one-time General Fund to accelerate implementation of the ZEV Market Development Strategy's focus on increasing awareness and access to ZEVs in the hardest to reach communities and expanding tools that help convert this awareness into decision to drive or ride in ZEVs.

Cap-And-Trade Spending Plan

According to the LAO, 2021-22 budget allocated \$3.4 billion GGRF for various programs. This plan included (1) \$1.8 billion in continuous appropriations, (2) \$186 million in other existing spending commitments, and (3) \$1.5 billion in discretionary spending. The plan assumed about \$2.8 billion in auction revenue in 2021-22, about \$700 million carried over from the end of 2020-21, and \$60 million in interest income accrued to the fund. Based on this revenue assumption and expenditure plan, the LAO estimated there would be a \$60 million GGRF fund balance at the end of 2021-22.

The chart below breaks down the Cap-and-Trade Discretionary Spending Plan in the 2021 budget.

Investment Category	Department	Program	2021-22
Equity Programs	Air Resources Board	AB 617 - Community Air Protection	\$260
		AB 617 - Local Air District Implementation	\$50
		AB 617 - Technical Assistance to Community Groups	\$10
	Community Services and Development	Low-Income Weatherization Program	\$15
	Water Board	Safe and Affordable Drinking Water (\$130 million total)	\$44
Low Carbon Transportation & ZEV Strategy	Air Resources Board	Clean Trucks, Buses, & Off-Road Freight Equipment	\$315
		Agricultural Diesel Engine Replacement and Upgrades	\$170
		Clean Vehicle Rebate Program	\$100
		Clean Cars 4 All & Transportation Equity Projects	\$150
Natural and Working Lands	CAL FIRE	Healthy & Resilient Forests (\$8 901)	\$230
	Department of Food and Agriculture	Healthy Soils	\$25
Other	Cal Recycle	Waste Diversion/Recycling Infrastructure	\$130
	Air Resources Board	Woodstove Replacement	\$5
		Small Off Road Engines	\$30
Total			\$1,534

Source: Department of Finance

According to the LAO, the vast majority of allocations shown above support programs that received GGRF in prior years. Some key exceptions are:

- ***Support for Local Implementation of SB 1383.*** In 2020, CalRecycle adopted regulations requiring local jurisdictions to reduce methane emissions from organic waste. The budget provides \$60 million GGRF for grants to local governments to assist in the development and implementation of local programs needed to comply with SB 1383 regulations. (The Cap-and-Trade Expenditure Plan also includes \$70 million for an existing program that provides grants for organic waste diversion and recycling infrastructure.)
- ***Small Off-Road Engines.*** The 2021 budget provided \$30 million GGRF to provide incentives for small professional landscaping services to purchase zero-emission small off-road equipment, such as electric leaf blowers and lawn mowers.

\$200 Million Annual Continuous Appropriation for Forest Health Beginning in 2022-23. Budget related legislation establishes a \$200 million annual continuous appropriation from 2022-23 through 2028-29 for various forest health activities (also known as SB 901 funding). Similar to certain existing ongoing expenditures, the \$200 million will be taken “off the top” of annual auction revenue before the existing continuous appropriations are determined.

GOVERNOR’S JANUARY BUDGET PROPOSAL (2022)

Key Climate Change-Related Proposals. According to the LAO, the Governor’s budget includes numerous proposals related to climate change, some of which are presented as packages. This is in addition to full inclusion of 2022-23 funding that was agreed to by the Legislature and the Governor as part of the 2021-22 budget for different packages of proposals related to climate resilience, zero-emission vehicles (ZEVs), and drought. For example, the proposed budget includes \$2.1 billion that was part of a Climate Resilience package. Some of the key new climate-change proposals and packages include:

- ***ZEV Package.*** The 2021-22 budget agreement included a total of \$3.9 billion over three years for various programs to support ZEVs. The Governor’s budget includes \$660 million General Fund in 2022-23 consistent with this agreement. In addition, the budget proposes a total of \$6.1 billion over five years—\$2.7 billion in 2022-23 and \$3.4 billion in subsequent years—in additional funding for ZEV-related programs. This total includes \$3.5 billion from the General Fund (non-Proposition 98), \$1.5 billion in Proposition 98 General Fund, \$676 million from the Greenhouse Gas Reduction Fund (GGRF), and \$383 million in federal funds.
- ***Energy Package.*** The Governor proposes a total of roughly \$2 billion over two years (\$938 million in 2022-23 and \$1.1 billion in 2023-24), almost entirely from the General Fund, for various proposals related to clean energy and building decarbonization. Some of the funding would go to programs that the Governor proposed in his 2021 May Revision, but that were not adopted as part of the 2021-22 budget.
- ***Wildfire Resilience Package.*** The Governor proposes \$800 million from the General Fund over two years—\$400 million in 2022-23 and 2023-24—to implement various efforts to improve forest health and make communities more resilient to future wildfires. This is in addition to \$200 million annually from GGRF, which is already continuously appropriated from 2022-23 through 2028-29 as part of the 2021-22 budget package.

- ***Drought Package.*** The Governor proposes \$750 million one-time General Fund for a variety of activities to respond to current drought conditions and build the state’s resilience to weather future dry years. This amount includes (1) \$180 million for water conservation programs, (2) \$145 million to address communities experiencing water supply shortages, (3) \$250 million to set aside as unspecified “contingency” funding the Governor would propose for specific drought response allocations later in the budget process, and (4) \$175 million for various other drought-related activities. These funds are in addition to \$880 million General Fund proposed for water and drought-related activities in 2022-23 consistent with the 2021-22 budget agreement that included a total of \$4.6 billion across three years.
- ***Wildfire Suppression Proposals.*** The Governor’s budget provides augmentations for various proposals related to fire suppression. Some of the major fire protection-related proposals include: (1) \$400 million ongoing General Fund to improve the health and wellness of California Department of Forestry and Fire Protection (CalFire) firefighters; (2) \$190 million General Fund in 2022-23, along with some outyear funding, for equipment such as helicopters and fire engines; (3) \$175 million in 2022-23 (\$120 million in General Fund and \$55 million in lease revenue bonds) for CalFire capital outlay projects, and (4) \$69 million General Fund in 2022-23, increasing to \$81 million ongoing, to increase the availability of year-round fire crews.

In addition to the proposals identified above, the Governor’s budget includes numerous other proposals across a wide range of policy areas—such as education, workforce development, and transportation—to which the Governor draws a nexus to climate change.

Most recently, the Governor released two BCPs to appropriate set-asides for extreme heat and nature-based solutions from last year’s Climate Package agreement.

BCP: Addressing Extreme Heat. The Administration requests the allocation of the \$300 million General Fund Extreme Heat set-aside in 2022-23 and 2023-24 to advance implementation of the Extreme Heat Action Plan and deliver on the Governor’s climate and opportunity agenda, consistent with Chapter 258, Statutes of 2021 (Senate Bill 155). This proposal builds on extreme heat adaptation and resiliency programs funded through the 2021-22 Climate Budget and numerous proposals in the Governor’s Budget proposal, all of which advance the areas of near-term focus outlined in the Administration’s Extreme Heat Action Plan. Specific allocations include:

- \$220 million over two years to support cooling of communities;
- \$43 million to protect vulnerable populations and ecosystems from extreme heat impacts;
- \$20 million to increase understanding of the risks posed by extreme heat and what resources
- are available to keep them safe through a public awareness campaign; and
- \$17 million to invest in the alignment of the state’s response to extreme heat and High Road workforce development, and building California’s climate smart workforce through training partnerships, and apprenticeships in jobs and careers that address extreme heat.

BCP: Nature-Based Solutions. The Administration requests the allocation of the \$768 million General Fund Nature-Based Solutions set aside in 2022-23 and 2023-24 to support implementation of the 30x30 Pathways and Natural and Working Lands Climate Smart Strategies, and execute on the Governor’s nature-based solution agenda as called for in Executive Order N-82-20 consistent with SB 155 (Committee on Budget and Fiscal Review), Chapter 258, Statutes of 2021. Specific allocations include:

- \$378 million to build on the 2021 Budget Act investments in programs that fund statewide nature-

based solution implementation.

- \$228 million to support regional implementation of nature-based solutions.
- \$100 million to partner with California Native American tribes and invest in shared nature-based solution implementation priorities.
- \$52 million to expand educational and economic opportunities for California’s youth climate leaders through local and tribal conservation corps programs.
- \$10 million to support for additional strategic investments that deliver on specified goals across multiple departments.

ISSUES TO CONSIDER

The following are overarching issues to consider on the how the state funds activities addressing climate change:

- ***Climate Effects Would Impact Communities Throughout the State.*** The anticipated effects of climate change would vary by region and could affect communities and sectors differently. Some potential impacts include: (1) reduced public health from high heat events; (2) reduced water supply, water quality, and agricultural production from droughts; (3) increased energy costs from increased average temperatures; (4) increased risks to public safety and infrastructure from flooding and wildfires; and (5) degraded fish and wildlife habitats from higher temperatures, droughts, and changed ocean conditions. Keeping in mind the differences between regions of the state, not all climate-related issues present themselves with “one-size fits all” solutions — Many actions will need to be tailored to suit the characteristics and needs of the various regions.

For example, by the end of this century, if the more extreme projections of eight to 10 feet of sea-level rise come to fruition, the shoreline of San Francisco Bay — some 166 square miles of land will be subsumed. Sea-level rise not only consumes shorelines but also raises rivers and swamps the subterranean infrastructure of coastal communities, making a stable life there all but impossible. Coastal high points will be cut off from roadways, amenities and escape routes, and even far inland, saltwater will seep into underground drinking water supplies.

- ***Climate Change Likely to Increase Disaster-Related Costs.*** State and local governments incur costs to respond to and recover from major disasters such as wildfires and floods. To the extent that climate change increases the risk of such events, large one-time costs could result. For example, estimates suggest the state will pay more than \$2.5 billion to respond to and recover from the Camp Fire that occurred in Paradise in November 2018 (although the federal government is expected to reimburse the state for a large share of these costs). Also, the Camp Fire was the costliest single natural disaster in the world for insurers that year, resulting in \$12.5 billion in covered losses.
- ***Disaster-Related Costs Could Be Minimized Through Mitigation Activities.*** Recent research from the National Institute of Building Sciences found that undertaking certain prevention activities ahead of time can reduce the impacts from and costs associated with natural disasters. Such activities—commonly known as mitigation—can result in significant public and private savings by protecting health and safety, preventing damage to or loss of property and infrastructure, and reducing business disruptions. For example, the study found that within the “wildland-urban interface” where wildfires have more potential to cause costly property damage, federal grants for fire mitigation provide \$3 of benefit for every \$1 invested.

- ***Accountability Measures Where They Do Not Exist.*** Given the importance of the programs involved in these various sectors, and the historic amount of funding appropriated last year, future reporting on outcomes will be important in holding the agencies accountable for delivering results.

CONCLUSION

Half of Americans now rank climate as a top political priority, up from roughly one-third in 2016, and three out of four now describe climate change as either “a crisis” or “a major problem.” The impacts of climate change are widespread. For example, according to *The New York Times Magazine* article, “The Great Climate Migration,” (Abraham Lustgarten, July 23, 2020), one influential 2018 study, published in *The Journal of the Association of Environmental and Resource Economists*, suggests that “one in 12 Americans in the Southern half of the country will move toward California, the Mountain West or the Northwest over the next 45 years because of climate influences alone. Such a shift in population is likely to increase poverty and widen the gulf between rich and poor. It will accelerate rapid, perhaps chaotic, urbanization of cities ill-equipped for the burden, testing their capacity to provide basic services and amplifying existing inequities.”

As the state, and the World, respond to climate change through mitigation and adaptation, the path towards a net-zero GHG emissions target is not entirely clear, but rather complicated. For example, GHG mitigation estimates come with a high degree of uncertainty. Plus, with more frequent and intense drought, wildfire, pest outbreaks, and other impacts, it will only become more challenging to achieve climate change mitigation goals. In addition to climate factors, parsing out the complex interactions between natural carbon cycles and human activity is extremely challenging.

The state has several climate-related goals and has implemented a variety of measures and programs to address climate change. Last year, a historic amount of one-time state funding was infused into investments responding to climate change; and the Administration proposes additional one-time funding in the January Budget proposal.

The need to mitigate and adapt requires a significant amount of funding and action. Responding to climate change necessitates perseverance and will take many years, decades, and beyond for the state, and the World, through a multitude of methods in a variety of sectors.

Staff Recommendation. Hold open.