3. GLOBAL CLIMATE CRISIS

Photo credit: In These Times

"The United Nations Intergovernmental Panel on Climate Change (UN IPCC) has recently concluded that to avoid severe climate consequences, GHG emissions must be reduced dramatically as soon as possible. …The report also shows that human actions still have the potential to determine the future course of climate."

– UN IPCC, 2021

Greenhouse gas (GHG) emissions are primarily associated with the burning of fossil fuels and deforestation, as well as agricultural activity and the decomposition of solid waste. GHG pollution has led to a trend of human-induced warming of the Earth's average temperature, which is causing changes in the Earth's climate. This increasing-temperature phenomenon is known as "global warming," and the climatic effect is known as "climate change." The most common human-produced GHG is carbon dioxide (CO_2).

The California legislature adopted the public policy position that "Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California." Further, the state legislature has concluded that

> The potential adverse impacts of global warming include the exacerbation of air quality problems, a reduction in the quality and supply of water to the state from the Sierra snowpack, a rise in sea levels resulting in the displacement of thousands of coastal businesses and residences, damage to marine ecosystems and the natural environment, and an increase in the incidences of infectious disease, asthma, and other human health related problems…Global warming will have detrimental effects on some of California's largest industries, including agriculture, wine, tourism, skiing, recreational and commercial fishing, and forestry (and)…will also increase the strain on electricity supplies necessary to meet the demand for summer air-conditioning in the hottest parts of the state. (Health and Safety Code §38501)

TRENDS AND PROJECTIONS

The United Nations Intergovernmental Panel on Climate Change (UN IPCC), in the "6th Assessment Report" (*Climate Change 2021: The Physical Science Basis*), updated the level of uncertainty of potential climate change in regions around the globe. The authors report that, in the Western North America (WNA) region, we can expect:

- Increases in drought and fire weather in WNA in observations and will continue to increase in the future particularly at higher warming levels (*high confidence*);
- Projected increase in extreme precipitation (*very likely*);
- Projected increase in river and pluvial flooding (*medium confidence*).

Common regional changes in North and Central America include:

Temperature change (mean and extremes) in observations in most regions is larger than the global mean and is attributed to human influence. Under all future scenarios and global warming levels, temperatures and extreme high temperatures are expected to continue to increase (*virtually certain*) with larger warming in northern subregions.

Relative sea level rise is projected to increase along most coasts (*high confidence*), and are associated with increased coastal flooding and erosion (also in observations);

Ocean acidification (along coasts) and marine heatwaves (intensity and duration) are projected to increase (*virtually certain* and *high confidence*, respectively);

Strong declines in glaciers, permafrost, snow cover are observed and will continue in a warming world (high confidence), with the exception of snow in northern Arctic (UN IPCC 2021a).

The UN IPCC 6th Assessment authors alert us to the urgency of both the threat and the opportunity we face (as summarized in the New York Times):

> Under most of the scenarios discussed in the report, warming will continue well beyond 2040, through the remainder of the century. In the worst cases, where the world does little to reduce emissions, temperatures by 2100 could be 3 to 6 degrees Celsius (5.5 to 11 degrees Fahrenheit) above preindustrial levels. That would have catastrophic consequences.
>
> But the report shows that aggressive, rapid and widespread emissions cuts, beginning now, could limit the warming beyond 2050. In the most optimistic scenario, reaching "net zero" emissions could even bring warming back slightly under 1.5 degrees Celsius in the second half of the century.
>
> Such a scenario would be a mammoth and expensive undertaking for the world. It would also require a level of political will that most governments have so far been unable to muster (Fountain 2021).

"The evidence is clear that carbon dioxide (CO_2) is the main driver of climate change, even as other greenhouse gases and air pollutants also affect the climate."

– United Nations IPCC, 2021

GREENHOUSE GAS EMISSIONS BY SECTOR

Global GHG Emissions

Worldwide, the most GHG is emitted from producing electricity and heat emits, and second most is the transportation sector: The burning of coal, natural gas, and oil for electricity and heat is the largest single source of global greenhouse gas emissions (25% of 2010 GHG emissions). The transportation sector primarily emits GHG from fossil fuels burned for road, rail, air, and marine transportation (14% of 2010 GHG emissions) (EPA 2021).

The graphics below show comparative emission sources for the U.S., California, and Humboldt County.

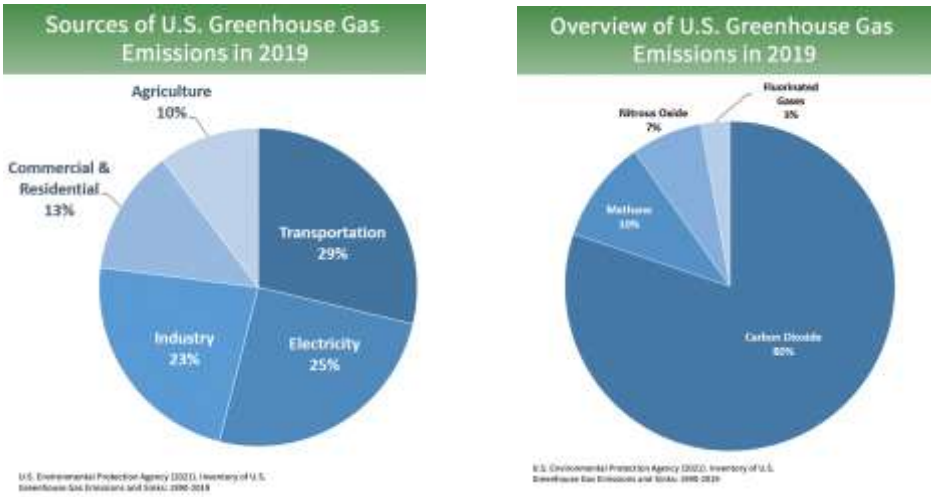


Figure *Climate*-1. **U.S. Greenhouse Gas Emission in 2019**

California GHG Emissions

California's overall GHG emissions peaked in 2004, and have generally trended down since. The transportation sector remains the state's largest source of GHG emissions. Transporation emissions declined from 2007 to 2013, then increased for four consecutive through 2017, and again decreased in 2018 and in 2019 (CARB 2021). In 2019,

> direct emissions from vehicle tailpipe, off-road transportation sources, intrastate aviation, etc., account for almost 40 percent of statewide emissions. When emissions from extracting, refining and moving transportation fuels in California are included, transportation is responsible for over 50 percent of statewide emissions in 2019 (CARB 2021).

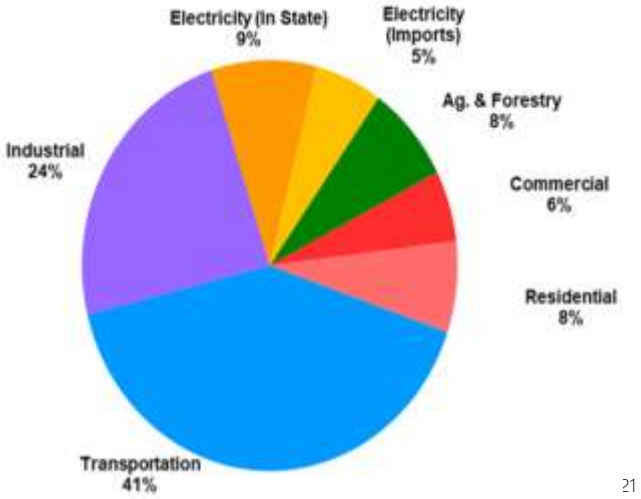


Figure *Climate*-2. **Sources of California Greenhouse Gas Emissions in 2019**

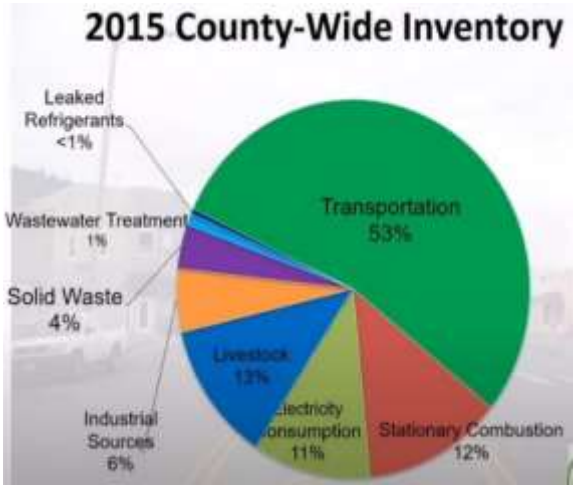


Figure *Climate*-3. **2015 Humboldt County Greenhouse Gas Emissions** (Draft County CAP)

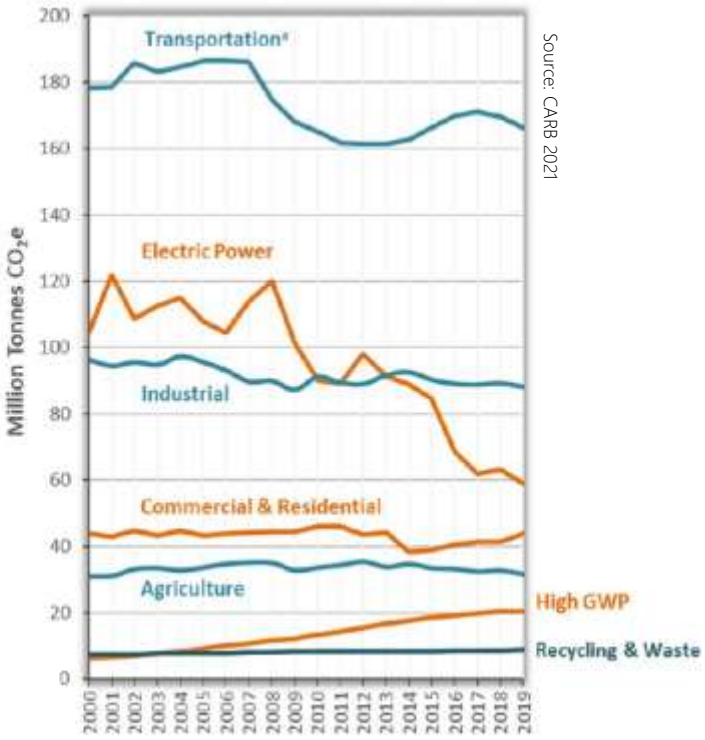


Figure *Climate*-4. **Trends in California GHG Emissions, 2000-2019**

CALIFORNIA CLIMATE ASSESSMENT

The State released, in 2018, the first part of *California's Fourth Climate Change Assessment*. For the statewide transportation sector:

- The increase in annual average and maximum temperatures is expected to raise the **costs of road construction** between 3% and 9%. Adapting roadway materials to withstand higher temperatures is needed to avoid potential costs of over $1 billion by 2070; and
- Over 3,750 additional miles of **highway** will be exposed to temporary **fooding** due to a 100-year storm event (Thorne 2018).

"A new study found that deep greenhouse gas emission reductions (80% below 1990 levels) in California could significantly improve health outcomes, and cost savings would be comparable to the cost of achieving those reductions by 2050. These savings are achieved because shifting from polluting technologies to clean technology improves air quality, saves lives, and improves overall public health."

– California's 4th Climate Change Assessment

NORTH COAST REGION

The "North Coast Region Summary Report" (part of the Fourth Climate Change Assessment) summarizes major climate change risks for communities and natural resources in Mendocino, Humboldt, Del Norte, Lake, Trinity and Siskiyou Counties. The report identifies the following key climate change effects for the region:

- **Season temperatures** will increase 3-5°F by mid-century (2040-2069) and 6-9°F by end-century (2070-2099). Winter season temperatures are expected to increase by a greater magnitude: 5-7°F by mid-century and 8-11°F by end-century. Interior regions will experience the greatest degree of warming.
- The North Coast region already experiences the most **intense storms** in the state in terms of three-day maximum precipitation. Climate change projections indicate that the intensity of individual storms will increase in the future (Pall et al. 2017, Prein et al. 2017, Risser and Wehner 2017).
- The frequency of **extremely dry years** is expected rise, on the order of 80% across most of northern California (Swain et al. 2018)
- **Annual precipitation** is not expected to change signifcantly, but will likely be delivered in more intense storms and within a shorter wet season. As a result, the region is expected to experience prolonged **dry seasons** and reduced soil moisture conditions, even if annual precipitation stays the same or moderately increases. Less precipitation will fall as snow and total snowpack will be a small fraction of its historical average.

- A rise in extreme precipitation events will increase the frequency and extent of **flooding** in low-lying areas, particularly along the coast where food risk will be enhanced with rising sea levels.
- **Sea-level rise** projections differ along the coast, but are greatest for the Humboldt Bay region and Eel River delta, threatening communities, prime agricultural land, critical infrastructure, and wildlife habitat.
- **Wildfires** will continue to be a major disturbance in the region. Future wildfire projections suggest a longer fire season, an increase in wildfire frequency, and an expansion of the area susceptible to fire.
- The impacts of these and other climate-driven disruptions will be disproportionately experienced by **vulnerable populations** in the North Coast Region. These include but are not limited to: low-income individuals, families, and people of color, women, the young, the elderly, people with disabilities, people with existing health issues including mental health issues, and people with limited-English profciency. These populations will ofen not only feel the immediate impacts of climate change more signifcantly, but also are less able to adapt to climate changes or recover from their impacts. (Grantham 2018)

NEEDS ASSESSMENT

CLIMATE CHANGE & SEA-LEVEL RISE IMPACTS TO HUMBOLDT

In Humboldt County, sea-level rise from global warming is compounded by local tectonic activity that causes downward vertical land movement, or tectonic subsidence. "Combining subsidence on Humboldt Bay with sea level rise over the last 100 years, tidal elevations have increased approximately 1.5 feet—the most of any area on the West Coast" (Russell and Griggs 2012 as cited by Trinity Associates 2015). Areas of former tidelands around the Bay are thus "as much as three feet lower than when they were salt marsh in the late 1800s/early 1900s" (Trinity Associates 2015).

Table *Climate-1*. **North Coast Region: Projected Average Annual Maximum Temperatures to 2099**

	HISTORICAL (1950-2005)	EARLY CENTURY (2020-2039)	MID-CENTURY (2040-2069)	END CENTURY (2070-2099)
Mendocino	65.4	68.1	69.9	72.8
Humboldt	60.4	63.2	65.1	68.2
Del Norte	57.4	60.0	61.8	64.8
Lake	68.0	70.9	72.9	75.8
Trinity	61.5	64.7	66.7	69.9
Siskiyou	60.0	63.5	65.9	69.4

Historical and future modeled annually averaged maximum daily temperatures (°F) for North Coast region counties under a business-as-usual (RCP 8.5) emissions scenario (Source: regional LOCA-downscaled data from ten priority global climate models).

Source: Grantham 2018

From the dual factors of land subsidence and global warming, in the Humboldt Bay region relative sea-level is rising at a rate two- to three-times greater than anywhere else in California. In fact, sea-level change at the Humboldt Bay North Spit tide gauge is much greater than any other tide gauge in the Pacific Northwest (Patton et al., 2017)" (Anderson 2017).

The areas at risk of tidal inundation are multiplied by Humboldt's miles of coastline, making Humboldt one of the most vulnerable counties in California.

Caltrans District 1, in partnership with HCAOG, led a regional climate change assessment, focusing on transportation assets and vulnerabilities. That report states that climate change is expected to increase sea levels in Humboldt Bay by a high-end estimate of up to 26 inches by 2050, and up to 70 inches by 2100. Precipitation is predicted to increase by up to 11% by 2050, and up to 14% by 2100, with estimated extreme runoff increases by up to 9% by 2050 and 12% by 2100 (Caltrans District 1 and HCAOG 2014).

"Transportation sector emissions vastly outweigh other carbon-producing areas of California's economy, and the recent spike should alert policy-makers that despite our best efforts, more must be done…"

– Adam Fowler, Beacon Economics

TRANSPORTATION ASSETS AT RISK

Around Humboldt Bay there are approximately 57 miles of shoreline structures—dikes, railroad, and highway/roads—that were constructed across former tidelands and function as barriers to bay waters. If these shoreline structures are overtopped (breached), the land uses, structures, and critical utility and transportation infrastructure located on these former tidelands are at risk of being inundated by tidal waters. Sea level rise would increase the risk to land uses and assets located on these former tidelands. (Trinity Associates, 2018)

Nearly 75% of Humboldt Bay's (almost 77 miles of the 102-mile shoreline) is covered by artificial shorelines. For example, U.S. 101 and State Route 255 are constructed on former tidelands that are protected by earthen shoreline structures (such as dikes). However, only 36% of the bay's shoreline (27.6 miles) is fortified. Nearly ten miles of low-lying shoreline, which currently protects US 101, has been rated highly vulnerable to breaching (overtopping) under current conditions during extreme tides (100-year event), or during annual king tides and/or storm surges that raise the tide by two feet or more above tidal baseline elevation (Trinity Associates 2015).

Dikes alone skirt almost 41 miles of the bay, and railroad approximately another 10, covering half of Humboldt Bay shoreline. The barriers are currently protecting thousands of acres of low-lying former tideland from tidal inundation. The man-made structures are providing barriers for transportation assets such as gas transmission lines, optical fiber lines, electrical transmission towers and distribution poles, highways, roads, city service streets, and a county airport (as well as other important regional infrastructure, agricultural lands, and tribal cultural resource sites) (Trinity Associates 2018).

Table *Climate*-2. **Surface transportation infrastructure (miles) vulnerable to 0.9 to 4.9 feet of sea level rise in the Humboldt Bay Area Plan (HBAP) planning area**

Surface Transportation Type	0.9 Ft.	1.6 Ft.	3.3 Ft.	4.9 Ft.	HBAP Total Miles
Local Roads	9.8	11.0	16.5	22.6	90.1
Collector Roads	1.0	1.6	3.4	5.6	23.6
Highways 101 & 255	5.4	6.1	8.1	9.6	16.2
Total	16.2	18.7	28.0	37.8	129.9

Source: Laird 2018

When the vulnerability to tidal inundation was assessed in 2014, the following transportation infrastructure (and associated water bodies) were reported to be the most at risk for flooding/inundation due shoreline structures (dikes, railroad beds. or other) being breached. The transportation systems (and associated water body) thus identified are:

Years 2015 to 2050, near-term conditions:
- Highway 101 (South Bay and Lower Arcata Bay)
- Highway 255 (North Arcata Bay)
- City of Eureka, City of Arcata, and County local streets and roads (Mad River Slough, Arcata Bay, Eureka Slough, Eureka Bay, Elk River Slough and South Bay)

Years 2050 to 2100, long-term conditions:
- Highway 101 (Upper Arcata Bay and Elk River Slough)
- Highway 255 (West Arcata Bay)
- City of Eureka, City of Arcata, and County local streets and roads (Mad River Slough, Arcata Bay, Eureka Slough, Eureka Bay, Elk River Slough and South Bay) (Trinity Associates 2015)

In the Humboldt Bay Area, the vulnerable roads and streets are concentrated in the City of Eureka and unincorporated communities of King Salmon, Fields Landing, Fairhaven, Samoa, and Manila (Trinity Associates 2018).

CALTRANS DISTRICT 1 CLIMATE CHANGE VULNERABILITY ASSESSMENT (2014)

Caltrans District 1 (Del Norte, Humboldt, Mendocino, and Lake Counties) was one of the first districts to complete a climate change vulnerability assessment. They assessed nearly 1,000 miles of the District's 23 roadways. Overall, the assessment concluded that the majority of the road network had low vulnerability to climate change, but several road segments were considered at risk, having both high criticality and a high potential for impact. Among the vulnerable road segments, high criticality scores were related to their limited redundancy (i.e., lack of alternative road routes) and presence of infrastructure assets such as bridges and stormwater facilities. (Caltrans and HCAOG 2014)

The Vulnerability Assessment identified the top three most vulnerable segments in each county in Caltrans District 1. The most vulnerable locations ("assets") did not change when different climate models predicted different impacts. The transportation assets in Humboldt County that the report found most vulnerable to climate change impacts are three segments of U.S. 101 in the greater Humboldt Bay Area:

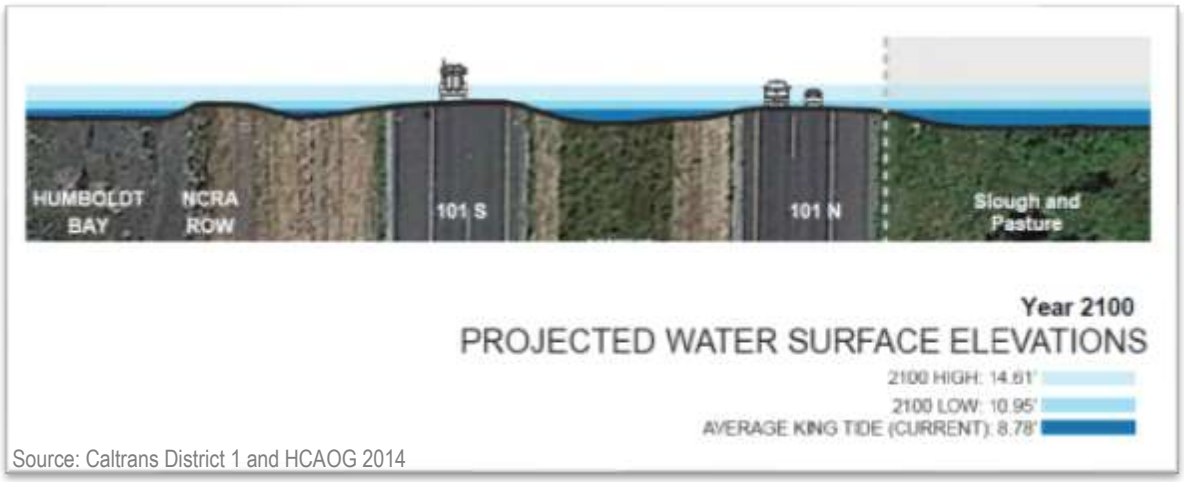


Figure *Climate*-5. **Highway 101 Vulnerability to Sea-Level Rise Along Humboldt Bay**
Water heights predicted for year 2100 under the high GHG emission scenario and the annual average King tide.

- **Rated most vulnerable: US 101** between Rio Dell and Eureka's southern urban boundary. Several portions of this segment are at low elevations and close to the coast/bay, creating a high potential for tidal inundation. This segment is deemed highly vulnerable in part due to its number of bridges, low redundancy (e.g., the bridge over the Eel River), and relatively high volumes of traffic (i.e., average daily trips, ADT).
- **Rated 2nd most vulnerable: US 101** between Eureka's northern city limits and the junction with State Route 255 (south Arcata). Some of the factors that make this segment critical are its high ADT and proximity to large population centers. Its low elevation and proximity to the coast make it more vulnerable to impacts from tidal inundation.
- **Rated 3rd most vulnerable: US 101** between Richardson Grove and Weott. The criticality and impact factors that make this segment vulnerable include having bridges over water, having many stormwater facilities, and the segment's drainage issues that have historically caused frequent slope movement (Caltrans District 1 and HCAOG 2014).

For the Vulnerability Assessment, stakeholders considered concepts for addressing sea-level rise along Highway 101 on Humboldt Bay. Concepts considered included increasing armoring/flood walls, elevating the roadway, and relocating structures. The six adaption options that were ultimately ranked highest (in this assessment process) are summarized in the table below.

CLEAN CARS & FLEETS: ZERO-EMISSION VEHICLES (ZEVS)

The State of California set ambitious targets for the number of zero-emission vehicles (ZEVs) on the road. ZEV technologies refer to battery electric vehicles, hydrogen fuel cell vehicles, and "transitional" plug-in hybrid electric vehicles—all of which can support the goal to reduce tailpipe emissions (CTP 2050). As the technology, market and funding for ZEVs is shifting rapidly, *VROOM* is

Table *Climate*-3 **Summary of Humboldt County-US 101 Prototype-Location Adaptation Options**

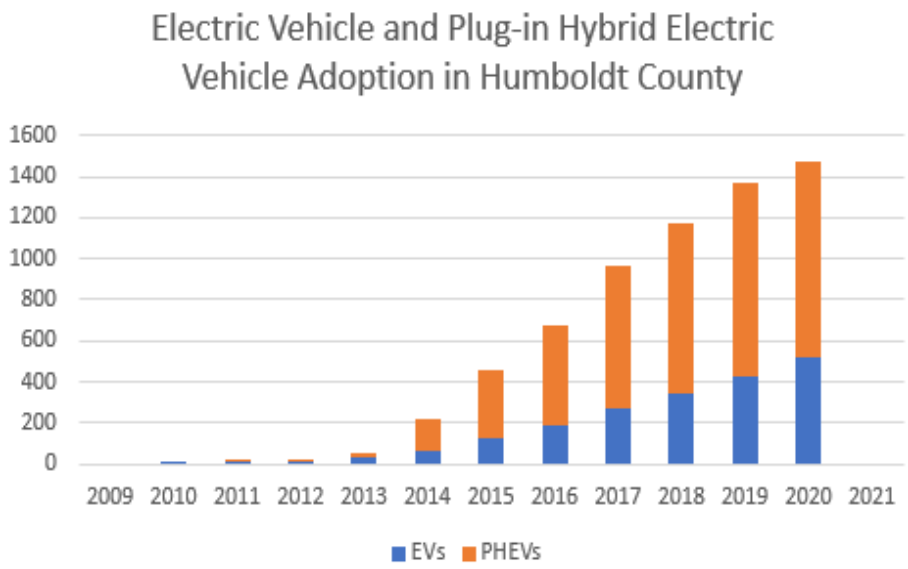
Rank	Adaptation Approach & Option	Project Description	2050 Cost Estimate (000s)*
1	"Defend" approach: Provide protection at existing elevations/ locations	Strengthen/add protection to existing protective structures (RR berm, dikes, fill areas) for 10 miles, including increasing height to 1 foot above 2050/2100 water level at a King tide	$121,000
2	"Accommodate" approach: Elevate the infrastructure above the impact zone	Increase height of the roadway by building up the fill prism 1 foot above 2050/2100 water level at a King tide for 6 miles	$61,000
3	"Accommodate" approach: Elevate the infrastructure above the impact zone	Construct a causeway, 6 miles, at a height of 5 feet above 2050 water level at a King tide	$174,000
4	"Retreat" approach: Relocate infrastructure (horizontally)	Assumed 8 mile re-route to the east of the existing Hwy 101	$350,000
5	"Changes in policies or practices" approach: Increase the interval for infrastructure maintenance & inspection and continue to monitor/evaluate	Equivalent to the No-Project alternative. Only temporary measures enacted and repairs made on an as-needed basis.	$950
6	"Retreat" approach: Temporarily restrict use of infrastructure	Install ITS infrastructure to recommend use of alternate route and increase signage and warning information	$1,000

*Order of magnitude, 2014 dollars. Source: Caltrans District 1 and HCAOG 2014

agnostic as to the particular type of zero-emission vehicle and infrastructure developed in Humboldt County. New vehicle types and their fuel sources should be considered with a full lifecycle analysis to ensure the least possible impact while still meeting regional transportation needs. In addition, ZEV policies and incentives must be distributed so that everyone, regardless of income or location, can benefit from clean cars.

The shift to ZEVs involves several vehicle classes. Federal and state incentives help drive the purchase of personal ZEVs. As more vehicles are manufactured and get to market, costs come down. Meanwhile, advances in battery technology are providing longer driving ranges. Models of pick-up trucks are expected to be on the market soon. Freight trucking is another class with dedicated state funding to support charging infrastructure and vehicle development for long-haul trucking. While much of the focus of ZEV policy is on cars and trucks, electric bikes are also gaining in popularity and market shares.

Zero-emission vehicles are at the forefront of advanced technologies such as autonomous driving. The California Office of Planning and Research published the guidance document, "Automated Vehicle Principles for Healthy and Sustainable Communities," which details strategies to manage the adoption of Connected and Autonomous Vehicles (CAVs). The adoption of CAVs should be focused on electric, shared-use vehicles that are part of efficient land use patterns.



Source: California Energy Commission Zero Emission Vehicle and Infrastrcutre Statistics, June 30, 2021.

Figure *Climate*-6. **Electric and Plug-in Hybrid Electric Vehicles on the Road in Humboldt**

Widespread adoption of ZEVs will require ample charging and alternative fueling infrastructure. According to the CEC, there are a total of 134 public charging stations in Humboldt. There needs to be coordination with local land use authorities to support ZEV charging stations at residential developments, job centers, and public buildings (CTP 2050). The use of the public right-of-way for charging stations will also be critical for broad transition to EVs.

HCAOG has partnered with Schatz Energy Lab, HTA and Redwood Coast Energy to better understand the technical limitations of charging a fleet of battery-powered public transit vehicles (HTA Battery Optimization Study). HTA, A&MRTS, and Blue Lake Rancheria Transit each have battery electric busses in their fleet. HTA is actively pursuing grants to further study hydrogen fuel cell bus technology in the rural context, with the goal of building hydrogen fueling infrasturcture and purchasing hydrogen fuel cell busses.

RTP GOAL, OBJECTIVES, & POLICIES

GOAL: *Reduce greenhouse gas emissions contributed by transportation while building and maintaining a transportation system that is truly multimodal and equitable.*

GOAL: *Minimize the negative health, social, economic, and environmental impacts caused by global climate change and sea-level rise.*

To strive for these goals, HCAOG shall support policies that help achieve the RTP's main objectives/planning priorities:

MAIN OBJECTIVES:	GLOBAL CLIMATE CRISIS SUB-OBJECTIVES (♦) & POLICIES
Active Transportation Mode Share/ Complete Streets	**POLICY CLIMATE-1. Carbon-neutral modes:** HCAOG will work and collaborate on efforts to promote non-motorized travel and the rapid transition to zero-emission motorized vehicles. **POLICY CLIMATE-2. Safe alternative modes:** HCAOG will support and plan transportation projects that provide safe and convenient travel modes for people who cannot or choose not to drive.
Efficient & Viable Transportation System	♦ Reduce motor-vehicle miles traveled (VMT) and lower GHG emissions. **POLICY CLIMATE-3. Clean fuels:** HCAOG will support efforts, including through public-private partnerships, to equitably expand transportation electrification, to optimize development and use of the electric grid, and to expand clean-fuel supply infrastructure.
Environmental Stewardship & Climate Protection	**POLICY CLIMATE-4. Adaptations for sea-level rise:** HCAOG shall encourage partnerships to develop adaptation strategies that address sea-level rise in Humboldt County. **POLICY CLIMATE-5. Traditional ecological knowledge:** HCAOG acknowledges the value of indigenous sciences and knowledge and the need for indigenous perspectives in responding to the climate change crisis. HCAOG shall work to support indigenous-led climate adaptation approaches, and shall work collaboratively with tribes and tribal governments for mitigation, adaptation, and resilience to climate change.
Equitable & Sustainable Use of Resources	♦ Recognize the connections between transportation and land use. **POLICY CLIMATE-6. Land use-transportation resilience strategies:** HCAOG will support local communities in developing integrated transportation and land use strategies for responding resiliently to climate change, and codifying such strategies in General Plans, Regional Transportation Plans, Local Coastal Programs, and other long-range plans. *(CTP 2040 recommended policy)* **POLICY CLIMATE-7. Equity for resilience:** HCAOG strives to assure that individuals and communities at greatest risk from climate-change related threats in Humboldt County, including low-income communities and communities of color, receive resources necessary to achieve sustainable resilience, mitigation, and/or adaptation.
Safety & Health	**POLICY CLIMATE-8. Health and safety:** HCAOG shall work to identify and implement critical mitigation, adaptation, and resiliency actions to protect Humboldt communities from health and safety threats from transportation-related impacts from extreme weather events (such as flooding, landslides, inundation, wildfire, windstorms, and heatwaves).

Facing the global climate crisis, California's governors and legislatures have passed laws enacting policies to actively address both the causes and the risks of climate change. Two of the foundational/early actions were Governor Schwarzenegger's Executive Order S-3-05 (2005) and the *California Global Warming Solutions Act of 2006* (AB 32, 2006), which set targets to limit GHG emissions equivalent to 2000 levels by 2010; and limit GHG emissions equivalent to 1990 levels by 2020.

California's GHG emissions targets for the next decades are:

By 2030	**Reduce GHG emissions** to 40 percent below 1990 levels	*Executive Order B-30-15 (Governor Brown 2015), SB 32 (Pavley 2016)*
	Renewable energy 60% of procurement portfolio	*SB 100 (De León 2018)*
By 2035	**100% zero-emission vehicle sales** (passenger cars and trucks)	*Executive Order N-79-20 (Governor Newsom 2020).*
By 2045	**Carbon neutrality** statewide and net-negative emissions thereafter	*Executive Order B-55-18 (Governor Brown 2018)*
	Renewable energy 100% of procurement portfolio	*SB 100 (De León 2018)*
By 2050	**Reduce GHG emissions** to 80% below 1990 levels	*Executive Order S-3-05 (Gov. Schwarzenegger 2005), AB 32 (Nunez 2006)*

In 2019, Governor Newsom signed Executive Order N-19-19 requiring California agencies to redouble efforts to reduce GHG emissions. The California State Transportatin Agency (CalSTA) is directed to leverage the more than $5 billion in annual state transportation spending for construction, operations, and maintenance to help reverse the trend of increased fuel consumption and reduce greenhouse gas emissions associated with the transportation sector.

RTPA's have a role in meeting these goals by conducting proactive, collaborative, and "adaptive" transportation planning that always considers the real threats of global climate change, and the large role fossil-fuel-based transportation plays in it. This RTP promotes integrating transportation and land use to reduce CO_2 emissions from the regional transportation system. The RTP's goal and targets to curb greenhouse gas emissions from the transportation sector complement the State's goals and targets in AB 32 and SB 375 and align with the state's climate goals.

ACTION PLAN: PROPOSED PROJECTS

Table *Climate-4*. **Regional Climate-Crisis Planning Projects**

Agency	Project Description	ST or LT*
HCAOG	**ZEV Infrastructure:** Work with agencies on infrastructure planning to optimize development and use of the electric grid and clean-fuel supply infrastructure, and to make more public right-of-way available for ZEV charging infrastructure. Support State efforts to strategically place charging stations, for battery electric and hydrogen-fuel cell vehicles, along California's designated Alternative Fuel Corridors, and advocate for Humboldt and other rural areas to receive fair benefits of the alternative fuel transportation corridors. (*California Transportation Plan 2050* recommended action)	ST
HCAOG	**Promote Electric Bikes:** Explore partnerships and incentive programs to support expanded use of e-bikes, such as programs that reduce the total cost of EV ownership Support educating agencies, businesses, schools, and residents about the benefits of electric vehicles. (*California Transportation Plan 2050* recommended action.)	ST

* ST = short-term: one to 10 years; LT = long-term: 10+ to 20 years.

RESEARCH AND PLANNING

STATE-LEVEL PLANNING

> "The CTP 2050 also reinforces long-held values such as improving system safety, improving mobility and accessibility, advancing environmental health and justice, and enhancing quality of life.
> *– California Transportation Plan 2050*

California Transportation Plan (CTP) 2050

The *California Transportation Plan 2050* (CTP 2050) must show, among other climate-response strategies, how California can reduce transportation sector GHG emissions to 80 percent below 1990 levels by 2050. *CTP 2050* sets policies and actions to collectively reduce transportation emissions through: clean fuel technologies; continued shifts toward active travel, transit, and shared mobility; more efficient land use and development practices; and continued shifts to telework.

State agencies must take climate change into account when prioritizing investment (per Executive Order B-30-15 and other climate legislation). Whenever applicable, agencies must use full life-cycle cost accounting to evaluate relative merits of infrastructure investments and alternatives.

Climate Action Plan for Transportation Infrastructure (CAPTI)

The California State Transportation Agency (CalSTA) and the California Transportation Commission (CTC) adopted the *Climate Action Plan for Transportation Infrastructure* (CAPTI) in 2021. CalSTA answers the question "Why is CAPTI necessary?" by stating:

> As the largest contributor to California's greenhouse gas emissions (GHG), reducing emissions throughout all aspects of the transportation sector is urgently needed to address the climate crisis.
>
> Even under the most aggressive scenarios for zero-emission vehicle adoption and a transition to cleaner fuels, California cannot meet its climate goals relying solely on a shift in transportation technologies. This means we must work to reduce our dependence on driving and reduce overall vehicle miles traveled to meet our climate goals.
>
> Moreover, reducing our dependence on driving is also key for our state's equity, healthy, and safety goals—not just climate. (CalSTA 2021a)

Adopting CAPTI, the state has commited that, "where feasible and within existing funding program structures,… the state will invest discretionary transportation funds in sustainable infrastructure projects that align with its climate, health and social equity goals."

To steer those investments, the plan has 10 guiding principles. Foremost is to "invest to create new clean transportation options,"

1. Building toward an integrated, statewide **rail and transit network**;
2. Investing in networks of safe and accessible **bicycle and pedestrian** infrastructure;

"(T)he state commits to investing billions of discretionary transportation dollars annually to aggressively combat and adapt to climate change while supporting public health, safety and equity."
– California State Transportation Agency 2021

3. Advancing investments in light-, medium- and heavy-duty **zero-emission vehicle** infrastructure;

   and to encourage people to adopt and use these clean transportation modes by:

4. Strengthening the commitment to social and racial equity by reducing public health and economic harms and maximizing community benefits
5. Making safety improvements to reduce fatalities and severe injuries of all users toward zero
6. Assessing physical climate risk for transportation infrastructure projects
7. Promoting projects that do not substantially increase passenger vehicle travel
8. Promoting compact infill development while protecting residents and businesses from displacement
9. Developing a zero-emission freight transportation system
10. Protecting natural and working lands." (CalSTA 2021b)

REGIONAL/LOCAL STUDIES & PLANNING

Some local jurisdictions joined the International Council on Local Environmental Initiatives (ICLEI), and resolved to participate in the Cities for Climate Protection campaign, such as the City of Arcata in 2000, and the County of Humboldt in 2007. Local jurisdictions have developed planning and policy documents designed to guide and prioritize measures to reduce GHG (and other air pollution) emissions:

- The **City of Arcata** prepared a *Community Greenhouse Gas Reduction Plan* in 2006, and has prepared subsequent GHG emissions inventories (the latest in 2014). In October, 2017, the City promoted Sea Level Rise Awareness Month, kicking off the first phase of a public awareness campaign to inform the community about current and potential effects of sea level rise in Arcata.
- The **City of Eureka** prepared a *Sea Level Rise Adaptation Planning Report* and an *Addendum No. 1* (December 2016). The Report provides draft goals and policies that could potentially be included in the City's Local Coastal Plan, as well as potential strategies that could be utilized to protect those priority assets. The City will prepare a GHG Reduction Plan as part of the EIR analysis of the General Plan. The GHG Reduction Plan will have measures that the City will implement to reduce GHG emissions.
- The **City of Trinidad** prepared a Draft Trinidad Climate Action Plan (2010) as background for updating the General Plan; the draft plan was designed to provide a framework for creating a CAP. In 2016, the City prepared a draft *Climate Change Vulnerability Report and Adaptation Response* as part of the its Local Coastal Program Update Project. The City will incorporate climate change considerations and adaption responses into their General Plan/Coastal Land Use Plan as appropriate.

- The **County of Humboldt** prepared a *Draft Climate Action Plan* (January 2012) as part of the Draft General Plan. The Draft General Plan includes the air quality policy AQ-P9 and implementation measure AQ-IM3 which direct that the County shall develop and implement a Climate Action Plan to reduce GHG emissions consistent with AB 32 and SB 32.

- The unincorporated County and the seven cities are partnering to develop and adopt the **Humboldt Regional Climate Action Plan** (draft), with strategies to meet legislative and executive orders to reduce countywide emissions by 40% of 1990 levels by 2030 and make progress toward zero net greenhouse gas emissions by 2045.[1] From 2030 to 2045, our community will need to fully transition from fossil fuels and make even deeper cuts in emissions from non-fossil sectors. A key outcome for the transportation sector is:

  > "*More accessible communities:* Implementing this CAP will make it easier, cheaper, and more fun to get around by improving accessibility of public transit; expanding shared mobility; expanding and increasing the safety of active transportation modes like walking and biking; and making communities more compact and connected."

- **Humboldt State University** (HSU) completed its initial Climate Action Plan in December, 2016, and met its first target to reduce their facility GHG emissions to or below 1990 levels by 2020. The campus is preparing "CAP 2.0," to be adopted in 2022,. to prioritize policies and projects to meet the goal of achieving carbon neutrality by 2045. HSU will "build climate resilience while addressing basic needs, equitable transportation and other social challenges while prioritizing the most vulnerable of our population."

- The **Humboldt Bay Municipal Water District** (HBMWD) discusses climate change in *Humboldt Bay Municipal Water District Urban Water Management Plan 2020* (June 2020) They conclude, based on the 2014 "Climate Change Vulnerability Assessment" and "California's Fourth Climate Change Assessment: North Coast Region Report" (2018), that "Overall, water supply and demand are projected to be of low to moderate vulnerability of climate change in the north coast region in general, and even less so in the Mad River watershed."

- The **Redwood Coast Energy Authority** (RCEA, a local government joint powers authority) has a goal to achieve net-zero greenhouse gas emissions countywide by 2030, which they outline in *RePower Humboldt: The Redwood Coast Energy Authority's Comprehensive Action Plan for Energy* (2019 Update). To advance low-carbon transportation, "RCEA will decarbonize regional transportation through efforts to reduce vehicle miles travelled, increase advanced fuel vehicles adoption and fuel efficiency, and expand advanced fuel infrastructure." RCEA also administers Humboldt County's Community Choice Energy program, which they turned on in 2017. Through the CCE, Humboldt customers can opt for a power mix of up to 100% renewable energy.

Figure *Climate-4,* depicts area around Humboldt Bay near Eureka (the second-most vulnerable transportation segment in Humboldt, according to the Caltrans District 1 Assessment), as it would be inundated based on projections (circa 2015) of SLR in 2050. This segment of US 101 is currently

[1] Governor Edmund G (Jerry) Brown, Jr., Executive Order B-55-18 to Achieve Carbon Neutrality. (9/10/18)

Figure *Climate*-7. **US 101 Eureka to State Route 255 Possible Inundation**
Inundation map of northeastern Eureka and Highway 101 with a half-meter of sea-level rise, which is predicted for the year 2050. Source: NHE 2015

protected from inundation by the natural shoreline, dikes or berms, and railroad or road grades, but it is vulnerable to existing and future sea levels (NHE 2015).

Figures *Climate*-8 and *Climate*-9 show existing flooding conditions (published 2015) of the north segment and middle segment around Humboldt Bay. Figure *Climate*-10 shows projected inundation areas of upper Arcata Bay Reach (north segment) for 2015–2050.

Assuming tidal elevation is 9.99 feet (MMMW+100-year stillwater level) and that protective shoreline structures are compromised north of Airport Road, extensive flooding of south and north bound lanes.

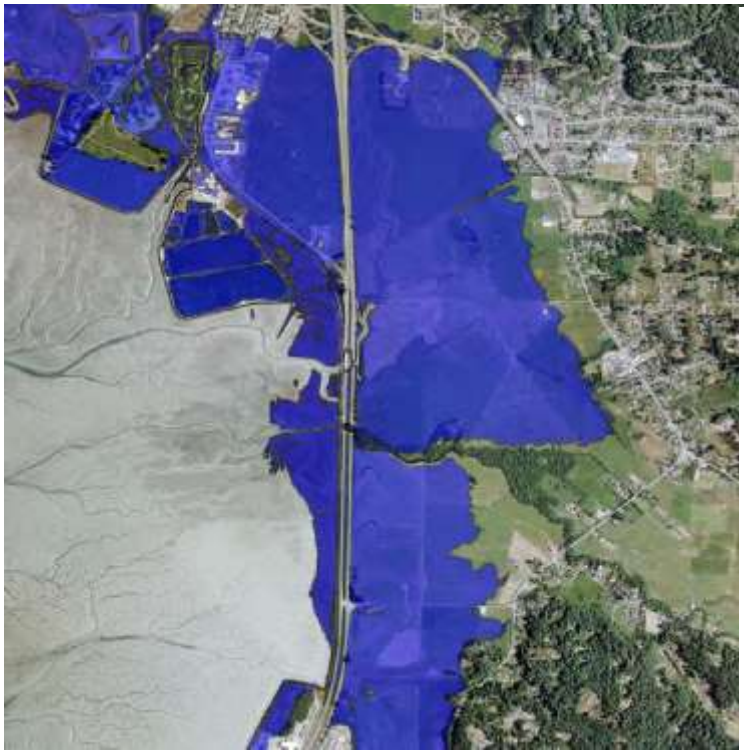
Source: Laird 2015

Figure *Climate*-8. **North segment, lower Arcata Bay Reach existing flooding conditions (2015)**

Assuming tidal elevation is 9.99 feet (MMMW+100-year stillwater level) and that protective shoreline structures are compromised, the land adjacent to the road prism is flooded to the west and east of Highway 101, with limited flooding of south and north bound lanes.

Source: Laird 2015

Figure *Climate*-9. **Middle segment, south of Eureka flooding conditions (2015)**



Assuming tidal elevation is 9.38 feet (MMMW+0.5 meter sea level rise) and that protective shoreline structures are compromised, the land adjacent to the road prism is inundated to the west and east of Highway 101.

Source: Laird 2015

Figure *Climate*-10. **North segment, upper Arcata Bay Reach projected inundation 2015–2050**

The Impacts of Sea-Level Rise on the California Coast (2016)

Table *Climate*-5. **Miles of roads and railways vulnerable to erosion and flood from a 1.4-meter sea-level rise along the Pacific Coast, by county and type**

County	Highways (miles)		Roads (miles)		Railways (miles)	
	Erosion-risk	Flood-risk	Erosion-risk	Flood-risk	Erosion-risk	Flood-risk
Del Norte	4.3	8.2	14	80	-	-
Humboldt	6.0	58	20	190	-	28.0
Marin	2.1	4.1	19	27	-	-
Mendocino	13.0	7.9	25	41	-	4.0
Monterey	11.0	31	15	110	2.1	23.0
San Francisco	0	8.0	17	25	-	-
San Luis Obispo	2.5	0.4	18	22	-	0.3
San Mateo	9.8	11	18	67	-	-
Santa Barbara	0.7	7.4	12	21	6.4	7.0
Santa Cruz	2.4	5.0	20	30	1.6	5.5
Sonoma	6.2	8.0	8.4	57	-	-
Total	58		180		10	

Note: Numbers may not add up due to rounding. Source: CCCC 2016 (Table 27)

"The Impacts of Sea-Level Rise on the California Coast" is a paper from the California Climate Change Center (CCCC 2016). The paper presents estimated length in miles and dollars in costs of infrastructure impacted by climate change. Impacts are calculated for the Californian counties and cities expected to be most at risk for impacts caused by climate change and corresponding sea-level rise. The paper states,

> Under current conditions, we estimate that 1,900 miles of roadway are at risk of a 100-year flood event. With a 1.4 m sea-level rise, 3,500 miles of roads will be at risk of flooding, nearly a doubling of current risk. Of the total, about 430 miles are highways (12% of the total mileage), while the remainder are neighborhood and local streets. About half of the roads at risk are around San Francisco Bay, and another half on the Pacific Coast.

The CCCC's paper shows that under current conditions, Humboldt County has the most miles of highway vulnerable to 100-year floods, with Orange County coming in second highest and Monterey coming in third. These three counties comprise 96 of the total 150 miles (2/3) currently at-risk, and over half of the highway miles at risk, statewide, with 1.4 meters of sea-level rise.

Other estimates presented in this paper include:

- Estimated length (in miles) and capital cost of required defenses needed to guard against flooding from a 1.4 m sea-level rise, by county; and
- Population vulnerable to flood and erosion from a 1.4 m sea-level rise along the Pacific coast, by county.

Three tables from CCCCs paper are reproduced below in Tables *Climate*-5 through *Climate*-7.

Table *Climate-6.* **Miles of roads and railways vulnerable to a 100-year flood in 2000 and with a 1.4-meter sea-level rise along the Pacific Coast, by county and type**

County	Highways (miles)		Roads (miles)		Railways (miles)	
	Current Risk	Risk with 1.4-m SLR	Current Risk	Risk with 1.4-m SLR	Current Risk	Risk with 1.4-m SLR
Del Norte	6.6	8.2	59	80	-	-
Humboldt	37	58	120	190	21.0	28.0
Los Angeles	14	31	42	140	5.6	14.0
Marin	1.2	4.1	22	27	-	-
Mendocino	5.6	7.9	28	41	2.7	4.0
Monterey	27.0	31.0	85	110	19	23.0
Orange	32.0	48.0	340	490	5.3	6.6
San Diego	0.6	8.0	12	57	3.0	9.8
San Francisco	0.2	0.4	17	22	-	-
San Luis Obispo	5.3	7.4	10	21	0.02	0.3
San Mateo	3.4	5.0	23	30	-	-
Santa Barbara	1.5	8.0	9.1	25	3.4	7.0
Santa Cruz	9.4	11	52	67	4.2	5.5
Sonoma	4.5	5.9	14	20	-	-
Ventura	2.4	11.0	69	150	3.7	10.0
Total	150	250	910	1,500	68	110

Note: Counties with borders on the Pacific coast and San Francisco Bay (e.g., San Mateo) were separated based on the shoreline affected. Numbers may not add up due to rounding. Source: CCCC 2016 (Table 15)

Table *Climate-7.* **Replacement value of buildings and contents at risk of a 100-year flood event along the Pacific coast, by county**

County	Current risk, in millions $	Risk with 1.4-meter sea-level rise (in millions $)	Percent increase
Del Norte	240	350	+ 43%
Humboldt	680	1,400	+ 110%
Los Angeles	1,400	3,800	+ 180%
Marin	220	260	+ 16%
Mendocino	120	150	+ 22%
Monterey	1,700	2,200	+ 36%
Orange	11,000	17,000	+ 63%
San Diego	690	2,000	+ 190%
San Francisco	670	890	+ 33%
San Luis Obispo	220	360	+ 67%
San Mateo	730	910	+ 26%
Santa Barbara	460	1,100	+ 140%
Santa Cruz	2,400	3,300	+ 34%
Sonoma	170	200	+ 20%
Ventura	980	2,200	+ 120%
Total	21,000	37,000	+ 71%

Note: All values are shown in millions of year 2000 dollars. Counties with borders on the Pacific coast and San Francisco Bay (e.g., San Mateo) were separated based on the shoreline affected.
Source: CCCC 2016 (Table 21)

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