

## APPENDIX C

# Summary of Climate Change Legislation, Forecasted Future Effects, and Sea Level Rise Studies

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This appendix includes a summary of recent legislation, a chart showing estimated time lines for projected climate changes and associated effects in the coming decades, and a summary discussion of local sea level rise studies.

### *Climate Change Legislation*

Since the CAP was adopted in 2012, new climate change legislation has passed. Details are focused on 2016-17 changes and more information about California climate change laws can be found on the state's [California Climate Change](#) webpage.

### *Federal*

At the federal level, although comprehensive climate change legislation has been proposed on several occasions, there is no federal law in the United States that explicitly requires public entities or private companies to mitigate their impact on global climate change although many other laws have the effect of requiring or encouraging such mitigation. The Center for Climate and Energy Solutions and Columbia Law School Sabin Center for Climate Change Law tracks federal legislation related to climate change.

**April 2016:** The *Paris Agreement* is signed by all members of the United Nations Framework Convention on Climate Change (UNFCCC) except Nicaragua and Syria. It is an agreement dealing with GHG emissions, mitigation, adaptation and finance within the UNFCCC. The agreement went into effect in November 2016.

**March 2017:** The Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) announced their intention to reconsider GHG emission standards for light duty vehicles model years 2022-2025. A public comment period was opened in August 2017.

**June 2017:** President Trump withdraws the US from the Paris Agreement, but the withdrawal does not go into effect until November 2020.

### *State*

Despite the US withdrawal from the Paris Agreement, California continues to be a leader in the fight against climate change. In recent years, the state has passed some of the most ambitious legislation regarding GHG emissions, and other countries have begun to turn to California for guidance. In June 2017, Chinese President Xi Jinping met with Governor Jerry Brown, shortly after the US withdrawal from the Paris Agreement, to discuss the next steps in fighting climate change. Relevant California climate change legislation includes:

**2005:** Governor Schwarzenegger issued Executive Order S-3-05 setting GHG emission targets of reducing GHG emissions to 2000 levels by 2020; reducing GHG emissions to 1990 levels by 2050; and reducing GHG emissions to 80% below 1990 levels by 2050.

**2006:** The Global Warming Solutions Act of 2006 (AB 32) requires California to reduce its GHG emissions to 1990 levels by 2020.

**2008:** Under the Sustainable Communities and Climate Protection Act of 2008 (SB 375), the California Air Resources Board (CARB) is required to set regional targets for GHG emissions reductions from passenger vehicle use. Each metropolitan planning organization (MPO) is required to demonstrate, 2017 Climate Plan Report

through the development of a Sustainable Communities Strategy (SCS), how its region will integrate transportation, housing, and land use planning to meet GHG reduction targets set by CARB.

**2009:** EPA grants a waiver allowing California to set vehicle standards for GHG emissions per AB 1493 (enacted in 2002).

**2010:** CARB establishes targets for GHG emissions reductions from passenger vehicle use in 2020 and 2035 for each region covered by one of the State's MPOs.

**2015:** Governor Brown issued Executive Order B-30-15 setting a new GHG emissions target for 2030 at 40% below 1990 levels. The 2030 target acts as an interim goal and increases the likelihood of success in reaching the 2050 goal (80% reduction below 1990 levels).

**2015:** California and Baden-Württemberg (a state in southwest Germany) initiated a first-of-its-kind agreement with international leaders, nicknamed Under2 MOU, to commit to either reducing GHG emissions to 80 – 95% below 1990 levels or limiting emissions to less than 2 metric tons per capita by 2050, in line with scientifically established emissions levels necessary to limit global warming below 2 degrees Celsius. As of September 2017, 187 jurisdictions representing 28 countries and six continents have signed or endorsed the Under2 MOU.

**2015:** The Clean Energy and Pollution Reduction Act of 2015 (SB 350) Establishes targets to increase retail sales of renewable electricity to 50% by 2030 and double the energy efficiency savings in electricity and natural gas end uses by 2030.

**2016:** Governor Brown signs three bills related to climate change: SB 32, codifying Executive Order B-30-15, requiring the state to slash GHG emissions to 40% below 1990 levels by 2030: 256 MMTCO<sub>2e</sub> (million metric tons of CO<sub>2</sub> equivalent); AB 197, prioritizing direct emission reductions from large stationary sources and mobile sources; and SB 1383, establishing statewide reduction targets for short-lived climate pollutants.<sup>1</sup>

**2017:** CARB proposes an update to the SB 375 GHG emission reduction targets for each MPO, which will take effect in 2018. SBCAG's proposed target based on this direction is described below.

**2017:** The California Global Warming Solutions Act of 2006 (AB 398) is amended to extend and improve the Cap-and-Trade program through 2030, which enables the state to meet its 2030 emission reduction goals.

### *Local/Regional*

In accordance with AB 32 and SB 375, the 2012 CAP targets a 25% reduction in city-wide 1990 GHG emission levels (estimated at 724,389 MTCO<sub>2e</sub>) by 2020 and a 30% reduction in 2005 per capita GHG emission levels (estimated at 4.413 MTCO<sub>2e</sub>) from passenger vehicle and light truck travel.

**2010:** CARB sets Santa Barbara County Association of Governments (SBCAG) target of 0% change from the year 2005 baseline in GHG emissions by 2020 and 2035.

**2017:** CARB's proposed new SBCAG target is a 13% decrease in GHG emissions by 2020 and a 17% reduction by 2035. A draft update to the Regional Transportation Plan and Sustainable Communities Strategy (Fast Forward 2040) is being prepared by SBCAG.

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<sup>1</sup> Short-lived climate pollutants are powerful climate forcers that remain in the atmosphere for a much shorter period of time than longer-lived climate pollutants such as CO<sub>2</sub>. They include methane, fluorinated gases, and black carbon (soot).

**Climate Change Effects**

Climate processes are complex, not completely understood, and not easily forecasted into the future. The timing, paces, and extent of climate changes ahead for California and Santa Barbara are uncertain. Research is underway at many academic and research institutions and agencies toward “downscaling” climate model information to local levels. The following chart summarizes available California or Santa Barbara projections and updates recent climate change effects.

The initial version of the chart below is Figure ES-2 in the 2012 CAP. CAP Strategy 69 directs updates to projected climate effects time lines be provided in status reports. Projections to the year 2050 were used to correspond to Governor Schwarzenegger’s 2005 Executive Order S-3-05 general goal of statewide annual emissions reduction to 80% below 1990 levels by 2050.

<b>Summary of Forecasted Future Climate Change Effects (2017 update shown in italics)</b>	
<b>Temperature, rainfall, extreme weather</b>	
Temperature	2050 projection (CA): average temperature increase: 3.2°F (low emissions) – 5.4°F (high emissions); more frequent heat waves. Recent studies predict a 3°F temperature increase in Santa Barbara County by 2050. <i>In CA, average annual temperature increased 1.7°F over the period 1895-2011. According to NASA and NOAA, the earth’s 2016 surface temperatures were the warmest since record keeping began in 1880. This marks the third year in a row a new record has been set for global average surface temperatures.</i>
Precipitation	2050 projection (CA): average rainfall decrease of 12–35%; less snow pack, more droughts. Santa Barbara County is projected to have fewer but more intense storms, leading to a decrease in the number of wet days per year and an increase in the number of days with extreme precipitation. <i>According to NOAA, from October 2016 to March 2017, California experienced its second wettest Water Year (WY) in 122 years, averaging 30.75 inches of rain, behind the storm season of 1982-1983. Santa Barbara County experienced 136% of normal rainfall in WY 2016 (Sept 1, 2016 – Aug 31, 2017).</i>
Wildfires	2050 projection (CA): greater wildfire risk (warmer, drier conditions). By 2050, 24 more high wildfire potential days than in 2000. <i>Since 2010, an average of 3 more large wildfires burn in CA than in the 1970s. Down from the nearly 900,000 acres that burned in 2015, the 3 major wildfires in 2016 burned only approximately 53,000 acres.</i>
Storm events & flooding	2050 projection (CA): more erratic weather patterns and extreme rainstorm events, with associated storm damage and flooding. <i>In 2016 - 2017, due to heavy winter storms, Santa Barbara County was hit with several mud slides and flash flood warnings. This was the second wettest year on record, since 1895, but by far the wettest February, which was when the majority of flash flood warnings occurred.</i>
Pests & vectors	2050 projection (CA): potential for altered transmission patterns for pests, vectors, and diseases. Increased toxic ocean algae blooms expected. <i>In 2016, freshwater toxic harmful algal blooms (HABs) caused by cyanobacteria have been escalating throughout the state. While there are still some HABs occurring around California, 2017 has not seen as many as 2016. As of August 1, 2017, the majority of HABs reported in the last 30 days have been in the Bay Area and Los Angeles regions. To date in 2017, West Nile virus has been detected in mosquitoes and birds in 18 CA counties, with 3 confirmed human cases. To date in 2017, mosquitos that carry Zika virus have been found in 12 CA counties.</i>
Air pollution	2050 projection (CA): increased smog production and changes to pollen production; reactive nitrogen disposition affecting plants

Summary of Forecasted Future Climate Change Effects (2017 update shown in italics)	
	<i>A short-term rise in particle pollution in 2016 was attributed to wildfires and drought. In the summer of 2016, the worst smog in years inundated Southern CA with the highest level of ozone readings since 2009. Much like the rest of Southern California, Santa Barbara County also recorded the highest level of ozone readings in 2015 and 2016, since 2009.</i>
Water pollution	2050 projection (CA): increased risk for pollution of streams (higher temperatures; urban runoff during intense storms); seawater intrusion into groundwater; ocean acidification affecting sea creatures. <i>Globally, measurements made over the last few decades have shown an increase in ocean acidification (OA) and hypoxia. Research indicates that the West Coast of North American will face some of the earliest, most severe changes in ocean carbon chemistry. Recent studies claim stream temperatures are likely to increase through the year 2100, but exact temperature changes will be dependent upon location, season, and elevation. According to a survey, the California Current system is reporting higher acidification earlier than anticipated, due to the substantial increase in carbon dioxide emissions. Organisms with shells are especially sensitive to this pH change as their shells disintegrate in high acidity. These negative impacts have already been reported in small swimming snails in the California Current.</i>
Sea level rise	
Sea level rise (from year 2000) <i>See page 3 for discussion of local sea level rise studies and forecasts</i>	2030 projections (SB): range 0.4 – 10 inches 2060 projections (SB): range 2.7 – 27 inches 2100 projections (SB): range 10.6 -60 inches <i>According to recent studies, global sea level rise accelerated rapidly from 1993-2014. Prior to 1990, sea levels rose about 1.1 millimeters (0.043 inches) annually. However, from 1993-2012, the average rise increased to about 3.1 millimeters (0.122 inches) annually. 2014 is the most recent year for which data is available, and the average rise was 3.3 millimeters (0.129 inches).</i>
Coastal flooding and inundation (multiple hazards to resemble large [100-year] coastal storm)	2030-2100 projections (SB): increased areas subject to 100-year flooding and inundation; permanent inundation of some low-lying areas. <i>Coastal flooding for portions of the City remains a key issue in the 2060 – 2100 timeframe. CoSMoS 3.0 is a modeling system designed to predict coastal flooding, incorporating sea level rise, storms, and long-term coastal erosion. Over the next century, CoSMoS predicts as much as two thirds of Santa Barbara County beaches will be completely lost due to erosion and flooding. Storms in early 2016 brought some minor flooding to the Santa Barbara area, but no permanent inundation.</i>
Beach erosion	2030-2100 projections (SB): potential erosion or loss of beaches, storm erosion leads to much higher loss, particularly from 2060 – 2100. <i>Evidence has shown Central California beaches have the highest percentage of beach erosion in California. In Santa Barbara County, Goleta Beach Park has taken the biggest hit from the massive storms and waves over the past couple of years. The county has responded with rock revetments, excess sand from Santa Barbara’s West Beach, sand berms, and buried fabric mesh to slow the erosion here, but to no avail. The Goleta Beach pier was heavily damaged in February 2017 due to powerful storms and waves.</i>
Coastal bluff erosion	2030-2100 projections (SB): increase in existing erosion rate with sea level rise; further increases when accounting for block failure, threatening cliff-top homes. <i>No known increases in bluff erosion rates to date. Updated modeling indicates coastal bluff erosion extending further inland than previously projected.</i>

<b>Summary of Forecasted Future Climate Change Effects (2017 update shown in italics)</b>	
<b>Public services</b>	
Water supply	<p>2030 projection (SB): adequate water supply.</p> <p>2050, 2100 projections (CA): increased pressures on statewide water supplies due to less rainfall and less water storage as snow pack, with increased irrigation demand and increased population.</p> <p><i>In May 2015, the Santa Barbara City Council declared a Stage Three Drought condition. This condition was most recently amended in March 2017, to decrease the City's water conservation target to 30%, in response to recent rains. This resulted in increased storage in Lake Cachuma and a filled Gibraltar Reservoir.</i></p>
Agriculture and food supply	<p>2050, 2100 projections (CA): alterations in crop yields, growing seasons, pest ranges from changes in temperature, rainfall, extreme weather, and water supply.</p> <p><i>After four years of severely dry conditions, a wetter 2016 winter and spring helped California partially recover surface water storage and aquifer recharge. The economic impact of drought to agriculture statewide was estimated at \$600 million in 2016 and 4,700 jobs.</i></p>
Energy demand	<p>2050, 2100 projections (CA): increased statewide energy demand with population increase, and more demand for cooling, peak summer demand, utilities, water transport, and industries.</p> <p><i>Energy demand statewide in 2014 grew by 1% over the previous year. Statewide energy demand is forecast to grow at a slower rate as a result of additional appliance standards and a reassessment of Title 24 energy efficiency standards for existing buildings.</i></p>
<b>Biological resources</b>	
Natural habitats and species	<p>2050, 2100 projections (CA): Varied species responses to changes in temperatures, rainfall, weather patterns, extreme events, wildfire, rising sea levels, coastal erosion, and air and water pollution. Individual species may adapt, survive in reduced ranges, migrate, or not survive. A general trend is anticipated for plant and animal species to move northward and upslope.</p> <p><i>Per a UCLA-led study in 2016, 15% percent of plant species in CA are moving northward and upslope.</i></p>
<b>Local economies</b>	
Fisheries and tourism	<p>2050, 2100 projections (CA): Marine habitat changes could affect fishing industry. Weather events, coastal erosion could affect tourism.</p> <p><i>Research from the Scripps Institution of Oceanography is showing wide-ranging declines in fish populations since 1970 in the California Current. In 2016 and 2017, weather events and coastal erosion particularly impacted Big Sur and Goleta Beach.</i></p>

### *Regional and Local Sea Level Rise Studies*

The following summarizes regional and local studies of sea level rise recently completed or underway.

**Coastal Storm Modeling System for Southern California (CosMos 3.0)** (US Geological Survey, 2017). The model downscales global data to predict future storm-induced coastal flooding and erosion in more localized areas with assumptions of future sea level rise and more extreme storm events. Model results are available on the Our Coast Our Future website.

**Project Webpage:** <http://data.pointblue.org/apps/ocof/cms/>

**Federal Emergency Management Agency (FEMA) Open Pacific Coast Study** (FEMA, pending 2017).

FEMA is working on a multi-year project to update existing coastal flood hazards information to produce 2017 Climate Plan Report

updated flood insurance rate maps (FIRMs). FEMA is also working on non-regulatory products that will include consideration of sea level rise.

**FEMA Web Site:** <https://msc.fema.gov/portal>

**Santa Barbara Area Coastal Ecosystem Vulnerability Assessment (CEVA, 2017)** (CA Sea Grant Study; UCSB, Scripps Institute of Oceanography, and US Geological Survey researchers in coordination with cities of Santa Barbara, Goleta, Carpinteria, and County). The study includes downscaled climate forecasts and assesses future impacts on coastal ecosystems including watersheds, wetlands, and beaches.

**Project Webpage:** <http://www.msi.ucsb.edu/current-projects/santa-barbara-area-coastal-ecosystem-vulnerability-assessment>

**City of Santa Barbara Refinement of County Coastal Resiliency Project (ESA, 2016).** Includes a refinement of baseline coastal conditions and sea level rise including the effects of shoreline protection and water control structures from Leadbetter Point to the eastern City limits.

**Santa Barbara County Coastal Resiliency Project (ESA, Revell, 2016).** Modeled sea level rise and other coastal hazards for Santa Barbara County, including the City of Santa Barbara, and assessing vulnerability. City is a partner along with Goleta and Carpinteria.

**Project Webpage:**

<http://longrange.sbcountyplanning.org/programs/Coastal%20Resiliency%20Project/coastalresiliency.php>

**City of Santa Barbara Sea Level Vulnerability Assessment (UCSB Bren School Master's Project group, Denka, Hall, Nicholson, 2015).** Analysis of future inundation, storm surge, and bluff erosion effects on populations, critical infrastructure, recreation and public access, and ecological resources.

**Project Brief:** [http://www.bren.ucsb.edu/research/2015Group Projects/documents/SeaLevelRiseSB Brief.pdf](http://www.bren.ucsb.edu/research/2015Group%20Projects/documents/SeaLevelRiseSB%20Brief.pdf)

**Goleta Slough Area Sea Level Rise and Management Plan (ESA, Revell, 2015).** A multi-agency study identified sea level rise and future effects on water levels and flooding, tides and sediment, water quality, habitats and species, and adaptation options to inform management of the Goleta Slough and environs including Airport.

**Project Webpage:** <http://goletaslough.org/>

**City of Santa Barbara Sea Level Rise Vulnerability Study (Griggs/Russell, UC Santa Cruz, 2012).** This grant-funded study assessed the likelihood and magnitude of greater future coastal hazards in Santa Barbara, including beach and cliff erosion, storm wave damage, flooding, and inundation, and identified potential adaptation options. (Study included as Appendix B of 2012 Climate Action Plan).

**City Website:** <http://www.santabarbaraca.gov/services/planning/erds/resource/cap.aspx>

## *Data Sources*

AGU Journal: <http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20248/full>

American Lung Association: <http://www.lung.org/our-initiatives/healthy-air/sota/>

Cal-adapt: <http://cal-adapt.org/>

California Climate Change: <http://www.climatechange.ca.gov/>

California Department of Public Health: <http://www.cdph.ca.gov/Pages/DEFAULT.aspx>

California Energy Commission – *Statewide Energy Demand*, 2016.

*California Freshwater Harmful Algal Blooms Assessment and Support Strategy*, January 2016. California Water Boards.

California Legislative Information: <https://leginfo.legislature.ca.gov/>

California West Nile Virus Website: <http://westnile.ca.gov/>

2017 Climate Plan Report

Center for Climate and Energy Solutions: <http://www.c2es.org/>

Climate Central: <http://www.climatecentral.org/>

Climate Central: Western Wildfires, A Fiery Future:  
<http://assets.climatecentral.org/pdfs/westernwildfires2016vfinal.pdf>

Columbia Law School: <http://web.law.columbia.edu/climate-change/resources/climate-legislation-tracker>

EPA Climate Change Indicators: <https://www.epa.gov/climate-indicators/climate-change-indicators-ragweed-pollen-season>

LA TIMES: <http://www.latimes.com/world/asia/la-fg-china-global-climate-20170606-story.html>

Mercury News: <http://www.mercurynews.com/2017/04/06/california-storms-this-water-year-now-ranks-2nd-all-time-in-122-years-of-records/>

NASA: <https://climate.nasa.gov/news/2537/nasa-noaa-data-show-2016-warmest-year-on-record-globally/>

NOAA Climate.gov: <https://www.climate.gov/news-features/event-tracker/record-setting-bloom-toxic-algae-north-pacific>

Noozhawk:  
[https://www.noozhawk.com/article/storms\\_waves\\_coastal\\_erosion\\_santa\\_barbara\\_county\\_historic\\_levels](https://www.noozhawk.com/article/storms_waves_coastal_erosion_santa_barbara_county_historic_levels)

Phys.Org:  
<https://phys.org/news/2017-05-acidified-ocean-widespread-north-american.html>

Santa Barbara County Public Works Historical Rainfall Information:  
<http://cosb.countyofsb.org/pwd/pwwater.aspx?id=3772>  
<http://cosb.countyofsb.org/uploadedFiles/pwd/Water/Hydrology/2016%20Hydrology%20Report.pdf>

West Coast Ocean Acidification and Hypoxia Science Panel *Major Findings, Recommendations, and Actions*, April 2016.

Scripps Institute of Oceanography: <https://scripps.ucsd.edu/news/californias-fish-populations-are-declining>

University of California Davis: <https://watershed.ucdavis.edu/droughtimpacts>

UCLA Newsroom: <http://newsroom.ucla.edu/releases/ecosystems-pulling-apart-as-some-plants-shift-habitats-possibly-adapting-to-climate-change>

USA Today: <https://www.usatoday.com/story/tech/sciencefair/2017/05/23/sea-level-rise-accelerating-study/102068034/>