Public Health Sector Plan

AGRICULTURAL SECTOR PLAN

BIODIVERSITY AND HABITAT SECTOR PLAN

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Public Health Sector Plan

Introduction

The task of public health is to promote and protect the health of people and the communities where they live, learn, work and play. While a doctor focuses primarily on treating individuals who are sick, the public health profession looks at the population level and concentrates on preventing people from becoming sick or injured in the first place. From conducting scientific research and monitoring diseases to educating about health and developing public policy that supports healthy behaviors and environments, the field of public health works to assure the conditions in which people can be healthy.(1)

Climate change is one of the most significant threats to public health of the twenty-first Century. (2) Climate change impacts health through a variety of environmental changes including warming, more extreme heat and other severe weather events, frequent wildfires, and droughts, a decline in air quality, and increases in allergens, and communicable and other diseases. Climate change also threatens the basic life support systems on which humans depend – our water, food, shelter, and security. The resulting human health impacts are varied and include increases in the risk and occurrence of asthma, allergies and other respiratory ailments, cardiovascular disease, vector-borne diseases, mental health impacts, civil conflicts and migrations, malnutrition, injuries, and heat-related illness and death.(3, 4) These challenges disproportionately impact the state's most vulnerable populations and require local, state, and national strategies that reduce the risk of climate change to the health of Californians, and increase their resilience over the long-term.

In response to Governor Brown's Executive Order B-30-15, which specifically addresses the need for climate adaptation and "actions [that] should protect the state's most vulnerable populations," the California Department of Public Health presents this plan to implement the recommendations of California's adaptation strategy document, *Safeguarding California: Reducing Climate Risk.* This is a living document that will be updated in view of forthcoming events and actions. This implementation plan articulates how the State of California can integrate climate adaptation into its public health planning and work, as well as how the work of other state non-health agencies and departments can improve public health.

The Governor's Executive Order and leadership on climate change adaptation recognize that climate change does not affect all people equally, and that resources must be focused on supporting the resilience of the people most vulnerable to the effects of climate change. People experiencing historical and current disadvantage due to discrimination based on poverty, race, ethnicity,

gender, sexual orientation, disability, geography, immigration status, and age tend to experience worse health outcomes on average. When these worse health outcomes develop through systemic, preventable and unfair distribution of power and economic resources, they are called health inequities.(5)

People experiencing health inequities are also likely to have fewer resources to prepare for, adapt to and recover from the health effects of climate change, be they sudden storms or fires, or slower-moving effects such as changes to crop viability resulting in job loss or food insecurity.(6)

The capacity for resilience in the face of climate change is significantly driven by living conditions and the forces that shape them (e.g., wealth, education, housing, transportation, environmental quality) and access to resources and services (e.g., health care, healthy foods and safe spaces for physical activity). Thus, strategies such as alleviating poverty, improving living conditions, increasing access to opportunity, and reducing health and social inequities will result in more climate-resilient communities.

Communities on the front lines of the climate change crisis caution that the goal of climate adaptation should not be to simply help people "bounce back" after disasters and other climate effects, because the underlying conditions of inequitable political power, participation in decision-making, and access to opportunities and resources will need to be changed in order to improve democracy, health, and sustainability.

Instead, frontline communities seek to "bounce forward", to a renewable, sustainable economy marked by inclusive democratic participation in the policy decisions that affect daily life.(7)

Responding to climate change provides opportunities to improve human health and well-being across many sectors, including energy, agriculture, housing, land use, and transportation. At the state and local agency level, public health agencies are investigating and addressing near-term health impacts, while also pursuing long-term preventive strategies. Many of these strategies offer a variety of benefits, often called health co-benefits, protecting people while combating climate change and providing other societal benefits.(9) These include promoting mitigation and adaptation policies and planning that provide health co-benefits and adaptive capacity, such as active transportation, urban greening, mixed use zoning, affordable, healthy, and energy-efficient housing, sustainable forestry and consumption of locally-grown produce. This approach includes enhancing local initiatives that are already building resilience to environmental threats to human health, including emergency preparedness and planning efforts.

Safeguarding California: Reducing Climate Risk relies on peer-reviewed scientific information

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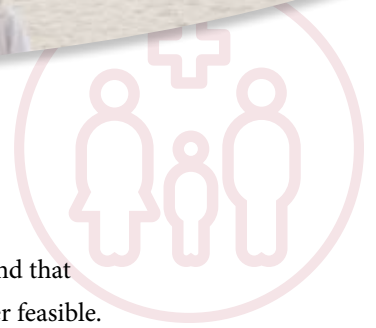
and expert judgment to identify vulnerabilities to climate change. For the Public Health Sector, it presents "actions needed for improved readiness for climate-related public health risks." The actions are categorized into three priority areas:

- Improving Capacity of Communities to Prepare, Respond, and Recover from Climate-Related Health Risks

- Better Understanding of Climate Impacts on Public Health

- Information Sharing and Education

This implementation plan presents updates to the actions recommended in Safeguarding California, along with current and proposed high priority initiatives, and more developed emphasis on improving human resilience to climate effects by reducing underlying vulnerability. It introduces new priorities that will be addressed in the 2017 update of Safeguarding California. The recommended initiatives are intended to continue building and strengthening partnerships and capacity in the state, tribes, counties and local communities. They are informed by the mandate in Executive Order B-30-15 for state agencies to prioritize actions that simultaneously build climate preparedness and reduce greenhouse gas (GHG) emissions; are flexible and adaptive;

that protect vulnerable populations; and that utilize natural infrastructure[1] wherever feasible. Recommendations and framing in the "Current Actions" and "Next Steps" sections were also informed by the following: state and external stakeholder feedback from 46 people working on public health and climate change; comments at six public workshops; and the documents *Preparing California for Extreme Heat* (20) and *Climate Change, Health, and Equity: Opportunities for Action*.(57).

This implementation plan prioritizes strengthening partnerships and ensuring the efficacy of public health vulnerability assessments, planning and implementation efforts. The local public health agencies, Disaster Health Care Volunteers (known nationally as Civilian Volunteer Medical Reserve Corps), the Alliance of Regional Collaboratives for Climate Adaptation, Building Healthy Communities Initiative sites, medical provider labor forces, nonprofits, tribes, and local communities are developing this emerging field of evidence-based practice in public health at the state, regional and local levels. Integrating local knowledge with scientific rigor will inform climate adaptation solutions that are effective for promoting health and equity in local communities and regions.

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[1] Natural infrastructure is the concept of having healthy functioning ecosystems that provide important services to human populations. Examples of natural infrastructure include forested watersheds that naturally treat and filter water, or wetlands and floodplains that regulate water flow and control flooding. For more information, see the World Resources Institute's publication, Natural Infrastructure: Investing in Forested Landscapes for Source Water Protection in the United States: http://www.wri.org/sites/default/files/wri13_report_4c_naturalinfrastructure_v2.pdf.

Vulnerability Assessment

Safeguarding California prioritizes identifying and addressing vulnerabilities to climate change. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as "the degree to which a [person or community] is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of…[exposure], sensitivity and adaptive capacity".(8) Climate change poses immense challenges for achieving health equity because, while all Californians are impacted by climate change, populations that are socially and economically vulnerable bear a disproportionate burden. People with low-incomes, some communities of color, those with existing health conditions such as chronic diseases and mental health conditions, young children and the elderly, people experiencing homelessness, outdoor workers and farmers, immigrants, some tribal nations, and socially or linguistically isolated people are most vulnerable to the impacts of climate change.(4) These are often the same communities where residents are less likely to have air conditioning, less likely to have trees in their neighborhoods, more likely to have one or more chronic medical conditions, and less likely to own cars to escape from natural disasters and extreme heat.(9)

Vulnerability to climate change is influenced by a complex interplay of a rapidly changing environment, drought, wildfire, extreme heat, sea level rise, air and water quality, the built environment (e.g., housing quality, affordability and availability; land use; transportation access and availability; neighborhood and workplace safety; etc.), and a host of socioeconomic factors.

These socioeconomic factors include the experience of racism and other forms of discrimination, employment, income, early childhood development and education, access to healthy foods, health insurance coverage and access to health care services, safety from crime and violence, culturally and linguistically appropriate services, and institutional policies such as banking, insurance, and social services.(5)

California counties have varying and unique indicators of risk. The urban areas of California, such as Los Angeles, San Diego, and the San Francisco Bay Area have the largest absolute numbers of people vulnerable to heat such as children and the elderly. Yet, rural areas, especially counties with low socioeconomic status, have high proportions of socially isolated elderly and elderly living in nursing homes.(10) Rural communities have fewer resources to plan for and respond to health impacts of climate change, are suffering more severe effects of drought, wildfire, agricultural and food security impacts, and yet are

the primary source of the clean air (due to forests), drinking water and food on which all Californians depend.(11)

The most pronounced health challenges, including the social inequalities that elevate human vulnerability to climate change are complex, interrelated, and preventable. Many policies and programs that impact health are not under the authority of the public health sector. Because of this, solving the urgent problems intensifying human vulnerability to climate change necessitates State sectors working collaboratively to address the factors that impact health and vulnerability (e.g., income, education, transportation, housing, etc.). The Health in All Policies approach formalizes the systematic incorporation of a health, equity, and sustainability lens throughout government through cross-sector collaboration.

The most immediate and concerning impacts for vulnerable populations continue to be extreme heat and air quality (i.e. wildfire smoke, ozone, particulate matter, criteria air pollutants, and allergens), as well as intermittent years of extreme precipitation such as El Niño years that can cause coastal and riverine flooding, and extreme prolonged drought. Combinations of climate hazards can occur simultaneously, synergistically, cumulatively, or in sequence, such as landscapes denuded by wildfire later having landslides in wet seasons.

Increased incidence of heat events results in increased heat illness and death as well as exacerbation of chronic disease conditions. The increased frequency of wildfires is also occurring in California due to precipitation changes and rising temperatures, aided by development in the wildland-urban interface and high fuel-loads that accumulate over decades owing to fire suppression. Changes in temperature also affect air quality by promoting the formation of ground-level pollutants, such as ozone.(12) This increase could offset much of the potential air quality improvements achieved through air pollution control measures, a phenomenon referred to as the "climate penalty."

Scientific evidence demonstrates that the climate is changing at an increasingly rapid rate, and that this change is outside the range to which society has adapted in the past.(13) Cal-Adapt[2] projects that urban and rural population centers throughout California will experience an average of 40 to 53 extreme heat days by 2050 and an average of 40 to 99 days by 2099. This compares to a historical average of four per year. Cal-Adapt defines extreme heat days as above the 98th percentile of the computed maximum temperature for locations

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[2] Cal-Adapt is a web portal developed in response to a key recommendation of the 2009 California Climate Adaptation Strategy. Cal-Adapt provides access to climate change data and scenarios, climate impact research, and visualization tools that can be useful for local decision-makers. For more information on Cal-Adapt, see: http://cal-adapt.org.

using 1961-1990 data for the May to October warm season.(14)

Human vulnerability to future heat events in the developed world, including California, is projected to include a future population that is collectively much more heat vulnerable than at present.(15) This is due to non-climatic factors such as an increasingly aging population and an increase in the prevalence of chronic disease, particularly among communities facing historic and current economic and social inequities. Californians age 65 and older are expected to more than double from 4.3 million in 2010 to 11.2 million in 2050, and those over 85 are expected to more than triple from 610,000 to 2.3 million.(16) Demographic changes account for the largest relative increases in heat-related mortality in the most vulnerable age groups.(17)

Cross-sector initiatives are underway to identify and respond to human health vulnerabilities attributable to climate-related exposures and socio-economic conditions, as well as strengthening adaptive capacity. Many local and regional initiatives and sectors have developed assessments that include indicators useful in determining vulnerabilities that impact human health. (See Appendix A for resources for California health vulnerability indicators, maps and information). Efforts to integrate public health considerations into climate adaptation planning across the State's sectors are and must continue to prioritize the people and places that are most vulnerable to climate impacts. Equally important, those most vulnerable must have the power and mechanisms to lead planning and implementation of the strategies that will shape their lives.

Current Actions

This section details the priority actions that are currently underway in California. They are organized under the sector-specific recommendations summarized in the *High-level vulnerability assessment and recommendations* section of *Safeguarding California*. To best illustrate the action being taken to protect Californians from climate impacts, the following initiatives were selected according to the following criteria:

- Did the initiative improve population health?

- Did the initiative create change in local living conditions?

- Were existing resources utilized to fill gaps?

- Was the initiative scalable and viable at the state-level and/or across sectors?

- Was the initiative viable and implementable across the public health sector?

- Did the initiative entail collaboration between different partners?

The following narrative is not exhaustive, but represents the broad efforts underway in California

to protect the health of its residents, organized by the recommended action they best fulfill from *Safeguarding California*. To get a fuller picture of California state government efforts that impact health, please see Appendix B.

1. IMPROVE CAPACITY OF COMMUNITIES TO PREPARE, RESPOND, AND RECOVER FROM CLIMATE-RELATED HEALTH RISKS

Communities need to have tools, resources, and information available to address climate challenges. Current actions focus on (a) planning for water-related public health risks and the vulnerability of California's public water systems, (b) improving health care infrastructure resilience to climate impacts, including the ability to provide care in the case of an extreme event, (c) supporting implementation of recommendations in the State's 2013 Extreme Heat Guidance Document, and (d) developing public health planning tools for local communities such as warning systems and surveillance of health conditions. These actions are further defined in *Safeguarding California* Public Health chapter.

State and local public health agencies can assist planners and emergency responders with resources (such as data and assessments of climate-vulnerable populations), guidance (such as health-related policies and adaptation interventions for climate action plans and general plans), and literature on the co-benefits of climate action on public health and health-related policies.(18)

Key initiatives include actions to improve models, projections, and available tools for adaptation

options and decision-making; addressing legal, regulatory, and institutional barriers to prepare for and respond to climate risks; improving our understanding of California's vulnerabilities and strengths in adapting to and responding to climate impacts; and implementing recommendations from previous adaptation plans and guidance documents (see Appendix B for details). A few highlights of these key initiatives include:

California Building Resilience Against Climate Effects (CalBRACE)

The federal Centers for Disease Control and Prevention's (CDC) framework, Building Resilience Against Climate Effects (BRACE), is an evidence-based public health practice to integrate adaptation planning into existing public health and medical provider planning efforts. The CDC funded the California BRACE (CalBRACE) Local Health Department Partnership initiative in the Office of Health Equity of CDPH. The partnership is piloting climate adaptation planning in the public health sector at the local and regional levels using the BRACE Framework. This initiative is currently working with 10 local health departments, and with further funding, could include more counties in the future. CDPH developed county-level climate and health profile reports and vulnerability assessments, and provides technical assistance and small contracts to local jurisdictions to build capacity for adaptation. The reports can help local, regional, and state jurisdictions identify the locations and populations that most need resources to prepare for the health impacts of climate change (reports

available at http://www.cdph.ca.gov/programs/Pages/CalBRACE.aspx)
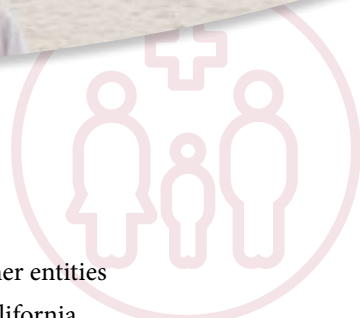
Climate Resilience Planning Among California Native American Tribes

Many California Tribes and indigenous communities in are putting resources towards planning for resilience in the face of increasing climate impacts. As one example, the Blue Lake Rancheria Tribe of California is a federally recognized California Indian tribal government and community located in Humboldt County. Blue Lake Rancheria's government, elected leaders, and staff have made significant progress implementing GHG reduction measures while improving community resiliency. The Tribe has implemented a wide range of projects that work in concert to reduce GHGs and improve community security, including actions to ensure operations for critical infrastructure and resource security during emergency situations. A few of the Tribe's milestones include developing several emergency preparedness plans addressing adaptation, conducting training of staff and community, completing more than 15 energy efficiency programs, installing solar arrays for low-income residents on the Rancheria, and signing an agreement with the American Red Cross to act as a shelter-in-place.(19)

Local Sea Level Rise Planning

The Ocean Protection Council, California Coastal Commission and State Coastal Conservancy administer a Local Coastal Sea Level Rise Adaptation Grant Program. This program encourages local governments and other entities responsible for planning under the California Coastal Act to adopt plans that conserve and protect coastal resources from future impacts from sea-level rise and related climate change impacts such as extreme weather events. This is an opportunity for local public health departments to get involved in planning for the health impacts of sea level rise.

Transportation and Health Impacts

The Integrated Transport and Health Impacts Model (ITHIM) is a tool to estimate the health co-benefits and potential harms from active transportation (walking and bicycling) and low-carbon driving scenarios in urban populations. It showed that increasing median daily walking and bicycling from 4 to 22 minutes in the San Francisco Bay Area reduced the burden of cardiovascular disease and diabetes by 14%, increased the traffic injury burden by 39%, and decreased GHG emissions by 14%. Low-carbon driving reduced GHG emissions by 33.5% and cardiorespiratory disease burden by less than 1%. The health benefits of active transportation far outweighed the morbidity and mortality from increased pedestrian and bicyclist injuries, but measures are needed to minimize pedestrian and bicyclist injuries when active transportation is

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implemented. Virtually all (99%) of the health benefits were a result of increasing physical activity rather than from reductions in air pollution (shifting to low-carbon driving). Together, active transport and low-carbon driving could achieve emissions reductions sufficient for California to meet legislative mandates. Some Metropolitan Planning Organizations (MPOs) around the state are utilizing the ITHIM tool to guide transportation and land use planning decisions that reduce emissions while improving population health.

In addition to climate change mitigation, this strategy achieves adaptation goals through its reduction in chronic illnesses, which increase vulnerability to climate change effects.(20) Many state agencies are engaged in transportation and land use planning that fosters walking and biking. Among them are the State Transportation Agency, the Air Resources Board of CalEPA, the Strategic Growth Council, and the Office of Planning and Research. The Transportation section of this document also describes progress on smart growth, advanced clean car standards, low-carbon fuels, and high speed rail that will help lower emissions from transportation and provide related health benefits that will be important in the face of climate risks such as more extreme heat events and worsening air quality.

Urban Heat Island

On average urban temperatures are 1.8—5.4˚F hotter during the day and as high as 22˚F hotter at night than rural areas.

Urban Heat Island Index

Supporting implementation of recommendations in the 2013 Extreme Heat Guidance, the CalEPA released the Urban Heat Island (UHI) Index in September 2015. A part of this work was to provide an UHI effect index for California that would allow cities to set quantifiable goals for heat reduction, including means to measure heat and GHG reduction benefits of various cool or sustainable materials strategies. The study "Creating and Mapping an Urban Heat Island Index for California", maps, and a fact sheet, available on the Urban Heat Island Index webpage (http://www.calepa.ca.gov/UrbanHeat/), were developed consistent with the Legislative intent in Assembly Bill 296 (Skinner, Chapter 667, Statutes of 2012).

> Together, active transport and low-carbon driving could achieve emissions reductions sufficient for California to meet legislative mandates.

Cool Pavements

The California Energy Commission (CEC) is conducting research on life cycle assessment and co-benefits of cool pavements, and with Lawrence Berkeley National Laboratory is substantiating models of the UHI effect to evaluate the efficacy of strategies to moderate the UHI effect

Healthy Soils

The Healthy Soils Initiative led by the California Department of Food and Agriculture offers promise in both reducing GHGs and promoting resiliency by storing water in soils, reducing

agricultural water needs, improving nutritional value of crops, and reducing the need for chemical inputs such as fertilizers, thus lessening the risk of exposure among farmworkers. (See Agriculture chapter for more information).

Green and Energy Efficient Buildings

Green Building Research

The California Air Resources Board (ARB) conducts green building research focused on reducing GHG emissions while also addressing any increases to other criteria air pollutants that can impact public health. Recently completed research projects include quantifying the GHG co-benefits of green buildings, as well as studying residential energy use and GHG emissions benefits from compact land use types. ARB contracted with Lawrence Berkeley National Laboratory to quantify the potential benefits of widespread deployment of cool roofs (light-colored roofs that reflect heat rather than absorbing it) in cities, which can help with reducing the urban heat island effect as well as counteract increases in urban temperatures associated with climate change. The ARB report, *"Using remote sensing to quantify albedo of roofs in seven California cities"*, was published in March 2014.(21)

California Green Building Standards Code (CALGreen)

California's Green Building Standards Code (Part 11 of Title 24, California Code of Regulations), also known as CALGreen, is overseen by the California Building Standards Commission (CBSC) and applies to new residential and commercial buildings throughout California. The aim of CALGreen is to increase energy efficiency, and improve public health, safety, and welfare through the use of sustainable practices in the design and construction of buildings. CALGreen consists of mandatory and voluntary measures that fall within five categories related to sustainable construction: (a) planning and design, (b) energy efficiency, (c) water efficiency and conservation, (d) material conservation and resource efficiency, and (e) environmental quality. The construction measures included in CALGreen address indoor air quality (i.e. assuring indoor air quality through addressing chemical emissions from composite wood products, carpets, resilient flooring materials, paints, insulation, and other materials). Requirements for cool roofs are also included in CALGreen to reduce the urban heat island effect, increase building energy efficiency, reduce energy costs, and improve the comfort of building occupants through lowering roof temperatures and the amount of heat that is transferred into buildings. Vegetated/green roofs and roof areas covered by solar photovoltaic panels are exempted from the requirements.

> The aim of CALGreen is to increase energy efficiency, and improve public health, safety, and welfare through the use of sustainable practices in the design and construction of buildings.

Through the Governor's Executive Order B-18-12, State agencies are directed to implement feasible voluntary measures from CALGreen to reduce energy use as well as ensure healthy indoor

environments for building occupants.

California Building Energy Efficiency Standards

The California Energy Commission's (CEC) Building Energy Efficiency Standards apply to new homes and commercial buildings, and offer builders better insulation, lighting, ventilation systems, and windows that will help to reduce energy use in homes and businesses. The measures in the Energy Efficiency Standards aim to reduce energy costs on consumer utility bills, maintain comfort in homes and businesses, and reduce GHG emissions. Measures in the Standards include solar-ready roofs that allow homeowners and businesses to add solar photovoltaic panels at a future date, more efficient/high performance windows, and cool roof technologies. For a more detailed discussion of the State's efforts to develop and implement a climate-resilient energy system, please see the Energy Sector Chapter.

Residential Energy Efficiency and Energy Assistance

The California Department of Community Services and Development (CSD) offers California residents assistance in making homes more energy efficient as well as in helping to pay for home energy costs. The CSD's federal Weatherization Assistance Program (WAP) is designed to help low-income individuals and families increase the energy efficiency of their homes for rental or owned properties. WAP also provides assistance in reducing the total cost of heating and cooling bills and helps to improve the health and safety of families (i.e., through sealing cracks and holes around windows, doors, and pipes; fixing or

replacing windows; and ensuring proper insulation levels). To date, around 60,000 low-income homes have been made more energy efficient through WAP. The Low-Income Home Energy Assistance Program (LiHEAP) is another federal program administered by CSD that provides assistance to eligible low-income households to meet immediate residential heating and/or cooling needs. Through CSD's Solar for All California pilot program, more than 1,000 income qualified families throughout California were able to install photovoltaic solar systems on their homes at no cost.

The California Public Utilities Commission (CPUC) offers the Energy Savings Assistance Program, which provides weatherization services at no cost to households who meet California Alternate Rates for Energy (CARE) income guidelines.

The California Energy Commission's 2015 *draft Existing Buildings Energy Efficiency Action Plan* includes a strategy to establish deeper subsidies for full participation in energy efficiency upgrades by low-income households, including in multi-family rental units. These are the families that most suffer from substandard housing and who most need energy efficiency upgrades to benefit from energy savings and reduce health risks such as poor indoor air quality, lead paint, mold, dust, cockroach allergens, extreme heat, and unsafe heating methods that increase risks of carbon monoxide poisoning and fire.

CDPH's Division of Environmental and Occupational Disease Control (DEODC) includes the California Breathing Asthma Program,

Childhood Lead Poisoning Prevention Program, Healthy Homes Program and Environmental Health Laboratories. The Environmental Health Laboratory Branch has an Indoor Air Section that provides technical assistance and information on Heating, Ventilation, and Air Conditioning systems, combustion safety, mold, and energy efficiency.

Urban Forestry

California Department of Forestry and Fire Protection (CAL FIRE) (through its Green Innovations, Green Trees for the Golden State, Urban Forestry Management, Urban Wood and Biomass, and Forest Legacy Programs) funded 17 applicants in 2014-15. This initiative addresses recommendations in the *2013 Extreme Heat Guidance* to promote and expand urban greening and the use of green infrastructure[3] cooling strategies in public and private spaces. While funded through legislation to reduce GHG, the Urban Forestry Forest Legacy Greenhouse Gas Reduction Fund also provides adaptive co-benefits for human health by cooling urban heat islands in cities. Trees also reduce air pollution, calm traffic, reduce neighborhood violence, and reduce storm water runoff, decreasing flood risk and soil and hill erosion while improving water quality.(22, 23)

Healthy Watersheds through Multi-Jurisdictional Stewardship and Collaboration

The Feather River Stewardship Coalition is a diverse community of willing stakeholders working to improve the ecosystem health of private and public lands within the Feather River Watershed, the headwaters of the state water project. In the Coalition, several agencies act together to mitigate wildfire, restore hydrological systems, as well as promote recreation and wildlife in the Feather River Watershed. The Coalition works to identify solutions that facilitate balance among community, economy, and environment. It integrates restoration of landscape-level ecological processes across jurisdictional boundaries while encouraging stewardship practices and socioeconomic development within the Feather River Watershed.

2. BETTER UNDERSTANDING OF CLIMATE IMPACTS ON PUBLIC HEALTH

Key initiatives include development of climate indicators to better monitor and prepare for climate change impacts; conducting assessments and mapping of communities most vulnerable to climate impacts; researching, monitoring, and tracking public health threats including wildfires and vector-borne diseases. A few highlights include:

> Trees reduce air pollution, calm traffic, reduce neighborhood violence, and reduce storm water runoff, decreasing flood risk and soil and hill erosion while improving water quality.

Health Impacts of Wildfire Smoke Exposure Research

The CDPH Environmental Health Investigations Branch is researching the public health impacts of

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[3] Per the US EPA, '[g]reen infrastructure uses vegetation, soils, and other elements and practices to restore some of the natural processes required to manage water and create healthier urban environments.' Green infrastructure strategies include the use of rain gardens and bioswales. For more information, see What is Green Infrastructure, US EPA: http://www.epa.gov/green-infrastructure/what-green-infrastructure.

wildfires, studying one or more large-scale wildfire events and existing datasets of medical events integrated with high-resolution modeled exposure data for particulate matter.

Bi-National Memorandum of Understanding to Enhance Cooperation on Climate Change

This 2014 memorandum between the State of California and the Ministry of Environment and Natural Resources and the National Forestry Commission of the United Mexican States aims to enhance cooperation on climate change and the environment. The purpose of this four-year agreement implemented by CalEPA is to carry out cooperative activities on climate change, human and environmental health, air quality, wildfires, heat, clean energy, and transportation based on principles of equality, reciprocity, information exchange, and mutual benefit.

Climate Change and Food-Borne Illness Outbreaks

According to the Division of Food, Drug, and Radiation Safety at CDPH, there are still no direct links from climate change to food-borne illness outbreaks. However, anecdotal evidence continues to indicate that this will be a much larger issue in the future as temperatures continue to rise. In 2015 there was an unprecedented algal bloom of *Pseudo-nitzschia*, which is a phytoplankton responsible for producing toxic domoic acid. Human consumption of bi-valve shellfish, anchovies, crabs, and other creatures that feed on the phytoplankton and concentrate the domoic acid in their digestive systems can lead to substantial injury and death.

The Environmental Management Branch and the Food and Drug Branch of CDPH worked collaboratively to scale up pre-harvest monitoring of harmful algal blooms (HABs) in the ocean and post-harvest seafood surveillance of potentially-impacted seafood products. CDPH worked closely with the Department of Fish and Wildlife to plan, map data, and discuss the most effective strategies for sampling, public risk communication, and regulatory actions needed based on results. Crab fishing in a significant portion of the state had to be closed in 2015-16 due to the risks. The unprecedented algal bloom was likely associated with the El Niño event, which some climate scientists believe will be an increased future occurrence due to climate change.(24)

> It is essential to develop culturally and linguistically relevant educational materials for diverse populations, to be disseminated via communication campaigns.

3. INFORMATION SHARING AND EDUCATION

This priority area highlights the need to disseminate information at both an institutional and public level. Actions include: (a) capacity building to raise awareness and foster action to address climate risks to public health, and ensure that public health and medical professionals are equipped with appropriate information to share with the public, and (b) public education on how to reduce and prepare for climate health risks. It is essential to develop culturally and linguistically relevant educational materials

for diverse populations, to be disseminated via communication campaigns. These actions are more fully defined in *Safeguarding California*, page 213.

Key initiatives include collaboration for public health and climate action planning, including workgroup meetings, trainings, and partnerships with other agencies and local governments; as well as providing resources and educational materials to inform the public regarding the health and equity impacts of climate change.

Highlights in California around information-sharing and education include the following initiatives:

### OutsideIn SLO Pilot Climate Change and Health Education Campaign

Outside In SLO: We Take Health and Climate Change Personally is a pilot climate change and health communications collaboration between the San Luis Obispo County Public Health Department and CDPH. It uses the framing that people can take action to improve both their own health and the climate by eating locally grown fruits and vegetables, walking, biking, taking transit, and advocating for policies that make it easier to engage in low-carbon lifestyles. Messages were delivered through Women, Infants, and Children Program (WIC) classes, at farmers' markets and other venues, through public service announcements, and written materials.

Climate Action Team Public Health Work Group (PHWG)

The California Climate Action Team (CAT) oversees 11 working groups, including the Public Health Work Group, which is co-chaired by CDPH and the Air Resources Board. The Work Group illuminates health and equity dimensions of activities to reduce greenhouse gas emissions as well as of actions to prepare for and adapt to the health challenges climate change brings. Quarterly public meetings are held in Sacramento and by webcast.

"BRACE-ing Ourselves for Climate Change: Making Every Step Matter"

The CDPH CalBRACE (California Building Resilience Against Climate Effects) program held a two-day workshop attended by 12 county health departments, Alliance of Regional Collaboratives for Climate Adaptation (ARCCA), Local Government Commission (LGC), West Oakland Environmental Indicators Project, Environmental Justice Coalition for Water (EJCW), and Building Healthy Communities representatives Urban Tilth and United Way-Merced. The participants discussed the health threats brought by climate change, and how to ensure meaningful participation and leadership by historically disadvantaged communities in planning to reduce vulnerability, prevent, cope with, and recover from health threats, and increase resilience. The CalBRACE program also initiated a national BRACE Communications Community of Practice online forum in collaboration with the Centers for Disease Control and Prevention and the Oregon, Arizona, and Illinois BRACE projects.
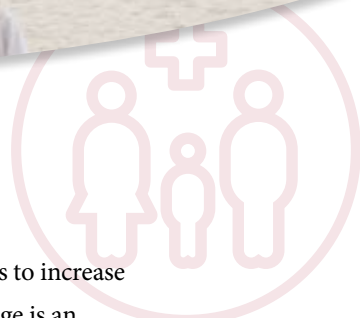
California Medical Association Foundation Climate Change Champions

The California Medical Association Foundation, in collaboration with the Network of Ethnic Physician Organizations, the Public Health Institute and the National Medical Association, is recruiting physicians and other providers to be Climate Change Champions. By mobilizing health provider champions, this two-year initiative aims to increase public understanding that climate change is an important public health issue and to build public support for climate change solutions. The initiative also intends to increase the relevancy of climate change to the experience of communities of color and expand the diversity of voices speaking about the impacts of climate change on health.

Next Steps

GAPS IN CURRENT EFFORTS AND RECOMMENDATIONS FOR ACTION

While existing efforts represent a comprehensive effort to protect the public health of the state and implement *Safeguarding California*, there are gaps in the current endeavor. CDPH, as the lead agency for climate change adaptation in the public health sector has identified additional actions where State leadership is needed to fill current gaps in the implementation of California's adaptation strategy.

Policy, systems and environmental change strategies that generally improve community health and well-being are required to improve the capacity of communities to prepare, respond, and recover from climate-related health risks. Here we include a range of high-level recommendations and best practices for strategies that provide co-benefits for health and climate change. While CDPH is not always the lead agency or department in the following recommendations, CDPH can partner, provide data, technical support, and connections with local health departments to assist the lead agency in considering health outcomes and reducing impacts on sensitive populations. Many of these actions are aspirational, and dependent upon identification of new funding sources, while some can be accomplished with existing resources.

In addition to the specific data sources suggested below, planners can access several sources of health data provided by CDPH. CDPH's CalBRACE project developed county-level climate and health profile reports and vulnerability assessments that can help local, regional, and state jurisdictions identify the locations and populations that most need resources to prepare for health impacts of climate change. The CDPH Healthy Communities Data and Indicators Project (HCI) is an indicator list providing evidence for the social, economic, and environmental links to health outcomes, data sources, and provides the ability to create local maps. Health departments also have access to

local data that is occasionally available at a more granular level.

ACTION: TRANSPORTATION

- Implement formal incorporation of health co-benefits and co-harms (e.g. chronic illness, bike injuries) into transportation models used in planning (e.g. ITHIM) in local, regional, and state transportation planning.(20, 57)

- Identify populations with climate vulnerabilities (e.g. highways projected to be inundated in floods) or limited access to transportation (e.g. low level of service, low-income transit dependent, etc.) to assist climate adaptive transportation planning and real-time transportation response in climate-related emergency events.

- Support and promote active transportation through support of increased funding for pedestrian and bicycle infrastructure and non-infrastructure programs and approaches such as Complete Streets, Safe Routes to Schools, Active Transportation Program, and incentives (e.g. tax breaks, transit subsidies).(57) Strengthen language in state and regional transportation and land use grants guidelines to improve public health and community engagement, and direct resources to communities facing transportation-related health inequities, low levels of active transportation, and low levels of transit service.

- Support public transit use, by providing funding for public transit systems and infrastructure, and discount transit fees (e.g. free school bus passes). (57)

ACTION: LAND USE

- Promote integrated local and regional land use, transportation, and housing planning that reduces social, environmental, and economic harms such as sprawl, residential and small business displacement, traffic, noise, air pollution, and loss of agricultural land and natural habitat. (57)

- Support healthy neighborhood design that incorporates mixed-use, mixed-income infill and transit oriented development neighborhoods with access to transit, jobs, affordable housing, and key amenities, and protections against the social, environmental and economic harms previously mentioned.(57)

- Consider requiring climate resilience planning including climate-related health impacts in Housing Elements and updates to Housing Elements.

- Integrate information from CDPH CalBRACE vulnerability assessments in order to identify county-level climate change and health assets and risks that integrated land use and "Sustainable Communities" planning could address.

- Promote consideration of health in planning and infrastructure decisions and processes (e.g. General Plans, Environmental Impact Assessment, Climate Action Planning, zoning). (57) Support prioritization of climate-adaptive infrastructure funding in low-income and vulnerable communities, especially in areas where aging infrastructure is at risk from climate change.(25, 26)

ACTION: COMMUNITY GREENING AND URBAN FORESTRY

- Increase parks, gardens, and shade trees, prioritizing disadvantaged communities and communities with few trees and parks. Use trees to provide shade for parking lots, parks, walking and bike paths, and tracks.(57) Community greening based on information in Urban Heat Island maps from CalEPA and in tree canopy cover and impervious surfaces maps and charts in CDPH CalBRACE vulnerability assessments.

- While promoting infill, create minimum required space for urban parks and community gardens in order to improve opportunities for physical activity, local food systems, and community cohesion.

- Balance the need for drought-tolerant, flowering, and fruiting plants with the need for shade, food, fire resistance, and open space for physical activity, taking into account the prevalence of allergies and asthma.(57)

ACTION: HEALTHY ENERGY EFFICIENT BUILDINGS AND SITING

- Support new and additional research on the health and climate change adaptation and mitigation co-benefits of (a) energy efficiency policies and building standards and (b) "net-zero" energy and energy efficient buildings, looking at new and existing residential and commercial buildings.

- Collaborate with State agencies and departments focused on green buildings and energy-efficiency to incorporate climate adaptation, health, and equity considerations into State initiatives, planning, and policies, including updates to the California Building Code and California Energy Efficiency Standards.

- Site buildings in locations with existing infrastructure and services to help reduce resource and energy use, while providing active transportation infrastructure and high level of public transit service connecting nearby locations, services, and amenities. (56)

- Facilitate greater collaboration between organizations that design and implement energy efficiency programs and those organizations that implement programs to improve health-related housing quality. Explore partnerships that combine funding for energy efficiency, indoor air improvements, and health improvement.

- Provide mitigation for poor indoor air quality for new and existing buildings sited within 500 feet of a freeway, including energy efficiency measures and high-efficiency particulate air filters and whole house ventilation systems. (27) Target residential energy efficiency funding and programs to populations with relatively higher ambient air pollution and ambient noise to reduce health inequities.(28) See Mitigating Negative Health Consequences of Strategies section below for more details.

- Develop funding or evaluative mechanisms to ensure that energy efficiency upgrades are installed and operate as intended and do not adversely affect building ventilation or other

indoor environmental quality factors and health consequences.

- Support implementation of California Energy Commission's (CEC) *Existing Buildings Energy Efficiency Action Plan* in transforming California's existing residential, commercial, and public buildings into ones that are high-performing and energy efficient.

- Increase funding and support for low-income energy efficiency upgrades and/or energy-efficient affordable housing. Make energy efficiency programs available for multi-unit housing through accessible financial mechanisms.

- Utilize green infrastructure, "low impact development", and low-energy strategies to manage building site stormwater runoff, reduce the urban heat island effect, and cool indoor air. Examples include:

  o Installing rain gardens, bioswales, and solar-reflective/light-colored permeable pavements.

- Plant trees, vegetation (such as green walls and green roofs), and use building shade to lower indoor temperatures and alleviate the urban heat island effect.(29, 57)

- Secondarily, improve access to and use of air conditioning, with attention to ways to offset the economic impacts on seniors and low-income groups and consideration of the energy use implications.(29)

- Consider the use of alternative green building standards/rating systems, such as the Living Building Challenge (LBC)[4],(30) in addition to LEED and other systems currently being utilized in State green building policies and requirements.

ACTION: HEALTH CARE SYSTEM CAPACITY

- Strengthen health care systems' capacities to prepare and respond to climate change events (e.g. power outages and hospitals closures) and provide continuity of medical care following extreme events (e.g. access to medication and medical records).

> The State Water Resources Control Board and local water districts need resources to develop preventative and adaptation actions to protect drinking water.

- Strengthen health care systems' capacities to respond to climate change health impacts (e.g. outreach to vulnerable populations during heat event or emergency response).

ACTION: PLAN FOR SEA LEVEL RISE AND FLOODS

Currently most wastewater treatment systems operate with gravity feed and thus are likely to be impacted by sea level rise if in a coastal area that may experience up to 66 inches of sea level rise by 2100.(31) Inundation could damage pumps and other equipment, and lead to untreated

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[4] Per its website, the Living Building Challenge™ is a building certification program that "defines the most advanced measure of sustainability in the built environment possible today".

sewage discharges. In addition to the flood risk to plants, higher water levels could interfere with treated wastewater exiting the facility if sited on the coast.(32) The State Water Resources Control Board and local water districts need resources to develop preventative and adaptation actions to protect drinking water. Wastewater treatment facilities could be encouraged to consider climate change impacts in their operations and facility upgrades by conditioning loans and funding on incorporating sea level rise and other climate change projections into plans. See the Water Chapter of this document for more information on this topic.

ACTION: COMMUNITY ENGAGEMENT AND CAPACITY BUILDING

The level of social capital or trust and connectedness in a community affects adaptive capacity.(33) Hurricanes Katrina and Sandy highlighted how important neighbors and local support networks can be in response to climate emergencies and disasters, when many residents were on their own for three days or longer before emergency responders arrived.(34) Community connectedness serves people year round, but particularly during emergencies when it can help people develop plans for mutual aid, or develop a system to check in on single, vulnerable or home-bound residents in the case of floods, storms, loss of electricity, etc. A community organizing model helps to build community capacity and social capital. Community organizing is "the process by which community groups are helped to identify common problems or goals, mobilize

resources, and develop and implement strategies for reaching the goals they collectively have set". (35) Community organizing also builds the social, political, or economic power of community members to make changes to meet needs and improve health. Health professionals can support community organizers with resources such as funding, data, and technical assistance. There is evidence that civic participation improves health at the individual level, and improves the governmental systems and decision-making processes that impact climate change planning and health over the long-term.

CDPH should seek resources to develop a climate change and health program to work with a diversity of populations on climate change adaptation planning to reduce vulnerabilities and increase resilience. For example, *promotoras* are Latinas who act as culturally sensitive health educators for the Latino community. There are many *promotora* groups across California; support could be provided to develop curricula, train and compensate *promotoras* to carry out community resiliency-building activities.

To engage communities and improve community health, climate change adaptation solutions should:

- Strengthen the skills, knowledge, and abilities of communities to participate in and influence decision-making processes;(57)

- Facilitate learning that increases community members' understanding of how to analyze and participate in decision-making around climate change, health, and equity, including the ability

to plan, organize, fundraise, and take action within the decision-making context;(57)

- Engage members of communities facing impacts of climate change to define what resources and training they desire, and collaborate with the communities to develop these self-defined community assets;(57)

- Support and strengthen community social networks and other assets to build climate resilience (e.g. partner with schools, faith-based communities, neighborhood-based groups and businesses in climate resilience planning);(57)

- Translate climate science to make it locally relevant and accessible for community members, and highlight health, climate, and equity impacts and opportunities.(57)

ACTION: INCREASED ADMINISTRATIVE AND TECHNICAL CAPACITY TO SUPPORT CROSS-SECTOR AND INTERNAL COORDINATION TO IMPLEMENT SAFEGUARDING CALIFORNIA

Prioritize implementation of adaptation strategies within the public health system, and build institutional capacity and mobilization through dedicated staff and resources within lead California Health and Human Services Agency (HHS) departments. CDPH will continue conversations with CDPH and HHS leadership to identify resources for staff to coordinate adaptation implementation, identify gaps and opportunities to inform strategic planning, and facilitate cross-sector collaboration and learning. A plan should be developed to provide dedicated funding to local health departments to lead community preparation

for the health impacts of climate change.

ACTION: LOW-CARBON OR NET-ZERO EMISSIONS STRATEGIES FOR KEEPING PEOPLE COOL IN EXTREME HEAT EVENTS.

Not having access to air conditioning has been shown to increase risk of illness or death in extreme heat events, which pose a higher risk to the elderly, people with mental illness, chronic conditions, low incomes, homeless, incarcerated, and other social or health-related vulnerabilities. Urban heat islands disproportionately impact low-income communities of color.(36) Thus, it is imperative to plan to keep vulnerable populations cool and safe in heat events. Yet operating air conditioning (AC) increases GHG emissions, increases heat immediately outside buildings running AC, can fail if peak demand causes power outages, and can be too costly for people with limited incomes to run. Thus, research is needed to provide methods of cooling that eliminate the need for increased AC. Effective techniques include urban greening, where (non-allergenic) trees provide shade and evaporative cooling, while greenery replaces pavement to reduce the urban heat island effect. Care must be taken

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to avoid tree limbs conflicting with photovoltaic arrays when siting trees. Green or living roofs and cool or light-colored roofs also provide cooling of neighborhoods, and significantly lower temperatures. Buildings can be made more resistant to heat waves with weatherization and energy-efficiency upgrades (see urban greening and green, healthy, and energy-efficiency buildings sections above for more detail). These techniques should be adopted into building codes and grant guidelines.

If the above cooling techniques are not sufficiently rapid or effective to protect health of vulnerable populations, personal cooling strategies should be used. The Center for the Built Environment at the University of California at Berkeley is researching development of "personal comfort systems" that use small amounts of energy to keep people comfortable. This involves ways to cool the hands and head area with little energy. However, these technologies are likely far from mass distribution. There may be a need to develop highly-efficient and inexpensive air conditioning units for distribution to low-income housing and senior housing in combination with other passive cooling techniques to decrease heat-related deaths and illness. Emergency responders and local health departments can partner to identify and outreach to vulnerable populations to access cooling centers or personal cooling resources.

ACTION: PREPARE FOR MOLD RESULTING FROM WATER INTRUSION INTO HOMES AND BUILDINGS

The Indoor Air Quality Program at CDPH

could compile existing published literature and best practices into a curriculum to prepare local environmental health departments to help residents prevent water intrusion and mold during and after severe storms and flood events, and to respond to questions and complaints about mold after flood and water intrusion events. The curriculum could include information on code enforcement, best practices, and resources for mold remediation, and be presented to all counties' environmental health departments and to the building industry.

ACTION: INCREASE RESOURCES FOR SURVEILLANCE OF HEALTH IMPACTS OF CLIMATE CHANGE.

In partnership across state agencies and departments, collect the necessary data to understand the impact of climate-related illnesses and deaths. Conduct routine surveillance of the underlying health, social, and economic factors that affect climate change vulnerability and resilience. For example, during heat events, data collected on health, social, and economic factors, as well as accurate accounting of heat illness and death, can inform public health planning and real-time responses.

- Working with CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) and the Governor's Office of Emergency Services (Cal OES), identify resources to implement recommendations of the *Preparing California for Extreme Heat* guidance. Recommendations include convening stakeholders in a work group,

reviewing CDPH's Electronic Death Registration System to determine how it could be modified to include a heat report supplement during heat waves, considering whether other early detection surveillance programs might be expanded to include heat illness for statewide surveillance (e.g., BioSense), examining developments in the Health Information Exchange that may present opportunities to collect heat illness data from electronic medical records (e.g., use of the early-detection surveillance module), and continuing discussions with the national Council of State and Territorial Epidemiologists regarding making heat death and/or illness a reportable condition.

- The steps above for heat surveillance can be applied to wildfire smoke. Surveillance methods to detect health impacts from heat and wildfire smoke could be disseminated to medical providers with technical support and web-based training.

- In order to avoid human cases of food-borne illness there is a need for increased surveillance sampling of food commodities for pathogens and other toxins.

ACTION: DEVELOP CURRENT DIGITAL MAPS OF LOCATIONS OF COMMUNITY WATER SYSTEMS

There are approximately 8,000 water systems in California, many struggling, and they are not all mapped. Knowing the location of water systems would aid resiliency planning for water security, triaging water needs, and emergency preparedness as the climate changes. The
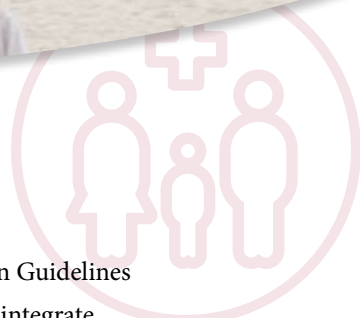
California Environmental Health Tracking Program of CDPH has been digitizing the spatial data on where community water systems exist in California (http://catalog.data.gov/dataset/california-community-water-systems-inventory-dataset-2010). However, this work is not complete and requires further funding to complete.

ACTION: PREPARE FOR MENTAL HEALTH IMPACTS OF CLIMATE CHANGE

In reviews of the literature on the relationship between disasters and mental health, post-traumatic stress disorder (PTSD) was most frequently observed and was considered to be "the most debilitating psychological disorder that occurs after traumatic events and disasters." Other mental health outcomes experienced were depression, nonspecific distress, and anxiety.(37, 38) Social capital, also called social cohesion, has been associated with mental health resilience following a disaster. Prolonged drought was associated with increased suicides in Australia, and there is anecdotal evidence that the unprecedented California drought of 2015 was associated with increased suicides in the Central Valley of California as water and dried up, and with it the livelihood of farm owners and farmworkers. (39) Recommended actions include providing information and resources to state and local mental health and behavioral health providers to

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prepare to support people suffering mental health consequences of the effects of climate change, providing psychological interventions in the wake of acute impacts, reducing the vulnerabilities contributing to their severity, and training to improve mental health providers' competency in addressing climate change-related impacts.(40) Actions that help mitigate and adapt to climate change, such as urban greening and shifting driving to walking and bicycling also demonstrate improvements to mental health.(20, 41)

ACTION: COLLABORATE WITH CAL OES AND THE EMERGENCY PREPAREDNESS OFFICE OF CDPH TO SUPPORT CITIES AND COUNTIES TO INCORPORATE CLIMATE, HEALTH, AND EQUITY CONSIDERATIONS IN THEIR UPDATES TO LOCAL HAZARD MITIGATION PLANS AND GENERAL PLAN SAFETY ELEMENTS.

California has been a leader in incorporating climate change considerations into required plans and documents. Senate Bill 379, approved by the Governor in October 2015, requires local jurisdictions to address climate adaptation and resiliency strategies in their next revision of a local hazard mitigation plan (starting in 2017), or in the safety element of the general plan (beginning in 2022, if the local jurisdiction has not adopted a local hazard mitigation plan). The bill requires the update to include goals, policies, and objectives based on a vulnerability assessment identifying the risks that climate change poses to the local jurisdiction. CDPH and local health jurisdictions can provide data on local health-related climate exposures and vulnerable populations. See Office

of Planning and Research General Plan Guidelines Updates for many examples of how to integrate climate change, health, and equity in general plans.

ACTION: PREPARE FOR CHANGING ENVIRONMENTAL CONDITIONS' IMPACT ON BASIC NEEDS, INCLUDING FOOD, AIR, WATER

- Strengthen local and regional food systems by supporting and creating incentives for establishment of urban and peri-urban agriculture, "farm to fork" programs, farmers' markets, and school and community gardens, for example through zoning changes.

- Advocate for the preservation of agricultural land and natural habitat.

- Support and promote sustainable agricultural practices such as water conservation, better management of livestock production (e.g. manure ponds), and practices that reduce soil degradation and the use of fossil fuel-based inputs such as pesticides and synthetic fertilizers (e.g. a fee on nitrogen fertilizers).

- Develop and/or utilize modeling and projections that take into account future anticipated climatic conditions for precipitation and water distribution. Base policy decisions on these types of projections versus solely depending on historical data to help prevent and plan for water shortages and plan for flooding and other extreme weather events.

- Support continued research and programs addressing anticipated climatic conditions regarding temperature, air quality, pollutants
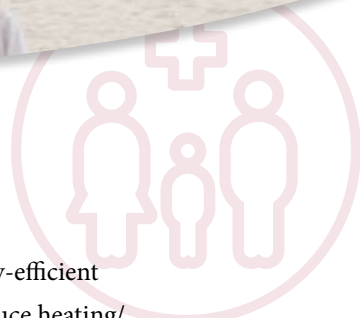
formation and dispersal, and other variables (e.g., higher temperatures leading to an increase in the formation of ozone and particulate matter).

ACTION: INCLUDE HEALTH, EQUITY AND RESILIENCE IN STATE FUNDING OPPORTUNITIES

CDPH should work with other state agencies to assure that public health, equity and resiliency are included as components or criteria on state funding opportunities for climate adaptation or mitigation. This has been accomplished for the Active Transportation Program and the Affordable Housing and Sustainable Communities Program.

ACTION: COLLABORATE TO PROMOTE RESILIENCE

CDPH should reach out beyond other state agencies and medical providers to encourage participation in climate resilience planning on the part of community health clinics, nonprofit organizations, community groups, local and state public health programs such as nutrition-promotion programs, mental health centers, health navigators and others.

MITIGATE NEGATIVE HEALTH CONSEQUENCES OF STRATEGIES

Certain climate adaptation strategies may negatively impact public health in unforeseen ways. For example, while buildings can be designed and constructed to be energy efficient, they may use construction materials and finishes that contain and release chemical toxins, which can then remain trapped inside energy-efficient buildings that are tightly sealed to reduce heating/cooling loss. If proper ventilation is not part of design, indoor air quality may be compromised and changing climate conditions can exacerbate problems such as mold. California's Energy Efficiency Standards for New Residential and Nonresidential Buildings includes ventilation requirements that meet or exceed current minimum state and national ventilation requirements. These requirements are consistent with best practices for the design of ventilation systems for newly constructed buildings as well as remodels of existing buildings. (42)

> CDPH should work with other state agencies to assure that public health, equity and resiliency are included as components or criteria on state funding opportunities for climate adaptation or mitigation.

Urban greening with certain species of vegetation can increase pollens and allergen exposure linked to asthma and respiratory diseases. This is a particular risk for vulnerable communities whose respiratory illness may be exacerbated directly by higher temperatures, as well as through heat-related increases in ground level ozone and particulate matter.(43)

Transit oriented development integrates housing, office, retail and other amenities into a walkable neighborhood located within a half-mile of quality public transportation. This can reduce

GHG emissions due to reductions in driving, while boosting physical activity, social capital, and overall health. However, care must be taken that housing is not situated right next to rail yards, major roadways or other sources of air pollution and noise without taking measures to protect the health of residents. Such health protective measures include requiring developers to face courtyards away from the roadway or rail line, installing high quality HVAC systems to filter air while maintaining ventilation, noise-proofing buildings, and planting trees and greenery to filter the air and buffer noise.(44) See Office of Planning and Research's General Plan Guidelines (final forthcoming).

Finally, while the intent of transit oriented development and mixed use zoning is to reduce greenhouse gas emissions, improve neighborhood conditions, increase housing choices and improve community cohesion, policies must be put in place to limit displacement of existing residents as livability improves and property values rise. When implemented in a way that explicitly considers the needs of low-income communities and communities of color, transit oriented development increases access to fresh and healthy foods, job opportunities, affordable housing, transit options, and safe places to walk, "roll", and recreate. However, transit investments and other amenities may drive up median area income, mortgages, property taxes, and rents. A possible result of such changes is that existing residents and small business owners may no longer be able to afford living or doing business there, and will be forced to move farther away. People with low incomes and people of color are currently most affected by displacement, and we are seeing a trend in California towards the "suburbanization of poverty" and communities of color. Displaced residents may end up further away from quality employment opportunities, schools and health-promoting resources such as healthy food retail and parks.(45) Furthermore, wealthier people moving into neighborhoods tend to have more cars and drive more. The consequences of displacement may include a decrease in sense of community and social capital, increased driving to get to services and jobs, and the decrease in health status that accompanies more sedentary behavior. These effects increase GHG emissions and underlying vulnerability to climate effects.

To prevent displacement from climate change adaptation and mitigation investments, it is essential to cultivate resident empowerment, leadership, and decision-making through training programs, guided reviews of plans, neighborhood scans, and mapping activities. Resident-led planning will generate buy-in, political mobilization, and relevant ideas to minimize displacement. Public health departments can assist in these activities. Many community development experts recommend that anti-

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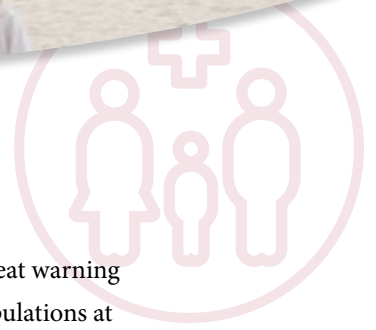
displacement mechanisms and policies be put into place before development of transit oriented, "sustainable communities", or smart-growth communities, so that existing residents can benefit from improvements. Some mechanisms that have been successful to ensure current residents are not displaced and can benefit from improvements include ordinances or community benefits agreements that result in affordable housing protection (at a deep level of affordability, for many decades), local hiring, guarantees that current residents get moved first into new housing units, and tax credits to control displacement. To help residents stay in their homes, municipalities can also consider code enforcement policies that assist residents with home improvements, rent controls, preservation of federally subsidized housing programs, and location-efficient mortgages that provide competitive rates and low down payments to those who want to live in "location-efficient communities" that are health-supportive, convenient, and reduce the need to drive.(46, 47)

RESEARCH NEEDS

To facilitate increased understanding of the health and equity impacts of climate change as well as mitigation and resilience measures, the following research topics are proposed:

- Provide data and technical expertise to local health departments and partners and facilitate asset mapping and climate vulnerability assessment.

- Evaluate the effectiveness of early heat warning systems geared toward working populations at high risk.

- Evaluate the extent of indoor heat illness among workers.

- Evaluate the feasibility of developing super-efficient air conditioning units that are inexpensive to operate and do not increase GHGs.

- Evaluate the past, current and likely future impacts of climate change effects on the mental health of Californians.

- Increase research on algal blooms in the Pacific Ocean and in local bodies of water, and their impact on shellfish, marine life, other plants and animals, and human health.

- Evaluate the effectiveness of cooling centers to reach the most vulnerable people and prevent heat illness and death.

- Evaluate how climate-induced changes to agriculture in California will impact health of both consumers and of farmworkers.

- Evaluate possible health effects of agroecology, or "carbon farming" through cover cropping, crop rotation, carefully managed grazing, using hedgerows to prevent erosion, minimizing tillage, and applying compost instead of chemical fertilizers.
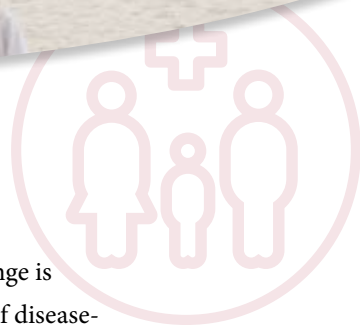
- Evaluate the impact of climate change on water-borne illnesses such as cholera, cryptosporidiosis, campylobacter, and leptospirosis.

- Evaluate the likelihood and possible health impacts of forced migration and civil conflict due to climatic changes.

- Evaluate to what extent climate change is affecting the range and prevalence of disease-carrying vectors such as the Asian tiger mosquito and other mosquitos.

- Evaluate if there are differences in public health outcomes between prescribed burning days and on days when wildfires are burning.

Monitoring and Evaluation

The Public Health Sector is engaged in multiple cross-sector initiatives and there is currently no centralized process for monitoring and evaluating all projects. Progress and effectiveness of climate adaptation actions can be measured through climate impact and resiliency indicators with both quantitative and qualitative methods (see Appendix C for a comparative list of selected indicators and screening methods).

As mentioned above, there is an immediate need for surveillance methods to determine the impacts of heat and wildfire smoke on human health in real time during events. Presently there is no unified system for collecting this data statewide. CDPH's Electronic Death Registration System could be modified to accomplish this. Surveillance will allow for a deeper understanding of vulnerabilities to heat and wildfire smoke.

The current OEHHA indicators could be expanded to include indicators for climate adaptive capacity that reduce injury and illness from heat and other climate exposures. This would include indicators that measure elements in the built environment such as impervious surfaces, tree canopy in urban communities, air conditioning, and others more closely associated with resilience and mediating vulnerabilities.

In measuring progress toward implementing *Safeguarding California* and improving resilience, two categories of indicators need to be measured, on as local a scale as possible:

- Indicators of vulnerability or resilience

- Indicators of actions taken and capacity built

Indicators of vulnerability include many of the metrics listed in Appendix C that are tracked by organizations interested in identifying vulnerability, disadvantage, and exposure to climate-related risks. Relevant vulnerability
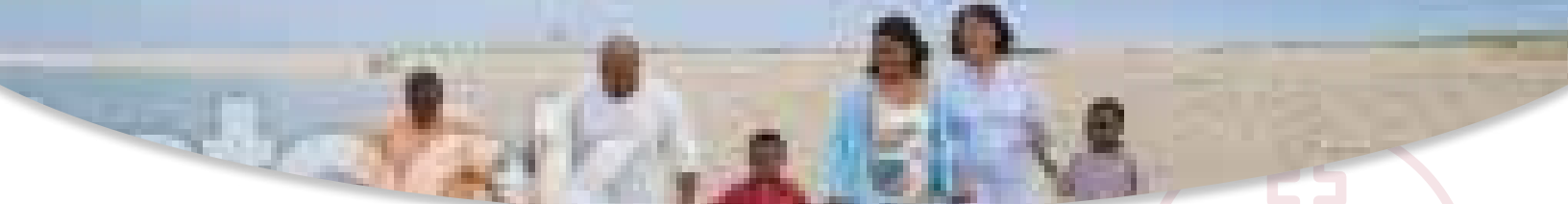
and resilience indicators to measure the recommendations in this document include:

- Poverty level

- Population living with mental illness

- Population with multiple chronic conditions

- Asthma diagnoses and emergency room visits

- Heat-related mortality and morbidity

- Wildfire smoke-related mortality and morbidity

- Food insecurity

- Years of potential life lost before age 65

INDICATORS OF ACTIONS TAKEN AND CAPACITY BUILT INCLUDE:

- Number of local jurisdictions with climate action plans, adaptation plans, general plans and hazard mitigation plans that address climate, health and equity

- Number of local ordinances adopted that incorporate climate, health and equity

- Number of low-income and senior housing units receiving weatherization and energy efficiency upgrades

- Number of cool roofs installed

- Number of green roofs installed

- Change in tree canopy coverage

- Change in impervious surface coverage

- Change in dark-colored, heat-absorbing surface coverage (e.g. asphalt)

- Number of local health departments funded to participate in climate resiliency planning

- Number of health care facilities incorporating climate and equity into emergency plans

- Number of community, neighborhood or nonprofit groups provided resources to engage in climate resiliency planning

- Expanded staffing capacity of CDPH to monitor and coordinate health-related adaptation activities at the state level, and provide support to local health departments engaging around climate change and health equity

- Number of forested acres sustainably treated for fire suppression

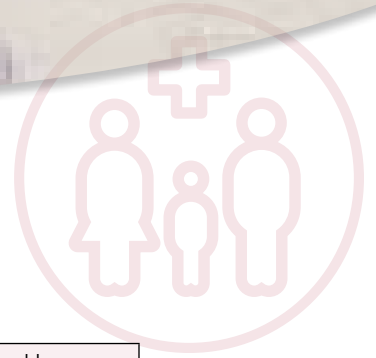- Number of communities with evacuation plans

Public Health

Cal-Adapt.org Energy	Cal-Adapt provides a view of how climate change exposures might affect California at the local level with maps and access to data. The data and information in this site is produced by the State's scientific and research community, and is in the process of being updated. Cal-Adapt is the result of a key recommendation in the *2009 California Climate Adaptation Strategy*.
CalBRACE CDPH	CalBRACE utilizes the Centers for Disease Control and Prevention's Building Resilience Against Climate Effects (BRACE) Framework for public health jurisdictions. Step One in the framework includes a vulnerability assessment that is being conducted initially for ten counties in California with 24 indicators in environmental exposures, social vulnerability and adaptive capacity domains. BRACE Step One entails identifying the scope of the most likely climate impacts, the potential health outcomes associated with those climatic changes, and the populations and locations vulnerable to these health impacts within a jurisdiction.
Indicators of Climate Change in California OEHHA	CalEPA's Office of Environmental Health Hazard Assessment (OEHHA) works on metrics for tracking climate change and its impacts on California's water resources, oceans, fish and wildlife, forests, agriculture, and the health and well- being of the state's residents. OEHHA released a 2013 update to its *Indicators of Climate Change in California* report, originally published in 2009. OEHHA convened a workshop on June 16-17, 2015 to solicit ideas and information for the next update of its Indicators report, scheduled for release in 2017.
CalEnviro Screen CalEPA	The California Communities Environmental Health Screening Tool: CalEnviroScreen Version 2.0 (CalEnviroScreen 2.0) is a screening methodology that can be used to help identify California communities that are disproportionately burdened by multiple sources of pollution. The tool provides added value for adaption planning to develop vulnerability assessments that overlay pollution sources with sea level rise, wildfires, air pollution, extreme heat or floods. The tool was updated in October 2014 to include additional data along the US-Mexico border.
Environmental Justice Screening Method (EJSM)	The Environmental Justice Screening Method (EJSM) was developed by the University of California at Berkeley, University of Southern California, and Occidental College. The EJSM provides a climate vulnerability layer in its mapping for the entire state of California, incorporating population sensitivities such as elderly living alone, car access, SES, and other metrics, with place-based characteristics that affect heat island risks such as green space and impervious surfaces. The tool identifies consistent racial disparities in vulnerability to climate risk.

Health Disadvantage Index (HDI)	HDI is a model cumulative index of community health disadvantage. It was developed by statewide public health department data experts by adapting international best practices and integrating 27 economic, social, environmental, and health data indicators. Sample HDI indicators include economic security, educational and employment opportunity, civic engagement, neighborhood quality, and premature mortality. Indicators are weighted based on their impact on human health, development and well-being.
Urban Heat Island Index	CalEPA released the *Urban Heat Island Index* in September 2015 to provide an UHI effect index for California that would allow cities to set quantifiable goals for heat reduction, including means to measure heat and GHG reduction benefits of various cool or sustainable materials strategies. http://www.calepa.ca.gov/UrbanHeat/
Publications in peer-reviewed journals OEHHA	OEHHA has published many articles in peer-reviewed journals identifying vulnerable populations for mortality and morbidity from heat exposure during the warmest months of May through September, ozone, or particulate matter in California over several years.

This table groups current actions according to the categories developed in Safeguarding California.

Improve Capacity of Communities to Prepare, Respond, and Recover from Climate-Related Health Risks

	INITIATIVES	SUMMARY
Planning for diverse climate change and water-related public health risks	Cleanup of contaminated sites prone to sea-level rise	Promote cleanup of areas surrounding Brownfields development in anticipation of SLR and potential for contamination from un-remediated adjacent sites during flooding.
	SLR Interagency Mapping Partners	Coastal Commission interagency work group focused on mapping sea level rise in California.
	California Health in All Policies Task Force – Implementation Plans	Incorporates urban greening recommendations from Preparing California for Extreme Heat Guidance into action plans of the Health in All Policies Task Force (enhance state agency coordination). Year: 2013　Agency: CDPH
	Collaboration to prepare for effects of sea level rise combined with floods due to El Niño-related storms	During the fall of 2015, the Ocean Protection Council and CalEPA along with the Governor's Office led multi-sectoral discussions of the environmental and human risks due to the confluence of sea leval rise, king tides and heavy winter storms influenced by the El Niño Southern Oscillation. These discussions included cross-border effects, with representatives of Mexico's emergency preparedness agencies. See website www.storms.ca.gov
	Urban Heat Island(UHI) Index Development	Addresses urban heat island effect, based on Recommendation I.2 of *"Preparing California for Extreme Heat"*. This is an inter-agency group that came up with definition of UHI index. Production of maps of the Index at the census tract level in California cities. Completed September 2015 Year: 2015　Agencies: CalEPA, DIR, CalOES, CDPH, NOAA/NWS
Evaluate health care infrastructure resilience	Health Care Facility Preparedness	There is extensive work happening in California to prepare health care facilities for the impacts of climate change such as sea level rise, increased storms, extreme heat, drought, etc. CalOES in collaboration with private, public and non-profit medical facilities, CDPH Hospital Preparedness and Emergency Preparedness Office all play a role in preparing for surges or disaster events.

Improve Capacity of Communities to Prepare, Respond, and Recover from Climate-Related Health Risks – C O N T I N U E D

	INITIATIVES	SUMMARY
OEHHA and CDPH Support implementation of recommendations in Extreme Heat Guidance Document	Updated Guidelines for General Plans	Internal CDPH work group convened by Health in All Policies staff to provide input into the update for the general plan guidance for county planning departments adding more emphasis on adaptation and social determinants of health to reduce vulnerability to climate change impacts to public health. Year: 2015 Agency: OPR – CDPH
	Conduct Epidemiologic Studies on Heat	Most epidemiologic studies on temperature during the warm season and heat waves focusing on California have been conducted within the past decade. Exposure has been defined primarily as apparent temperature, a combination of temperature and humidity. Outcomes that have been studied include mortality, morbidity, such as hospitalizations, emergency room visits, and in one study, preterm delivery. Air pollutants have often been examined as potential confounders or effect modifiers. The results have generally shown a positive association between temperature and various health outcomes, and have identified increased risk specifically for pregnant women, infants, young children, the elderly, and has varied by race/ethnicity. In addition to the typical heat-related illnesses, greater risk for both mortality and morbidity has been shown for specific cardiovascular diseases related to elevated cholesterol levels during heat exposure, such as ischemic heart disease and ischemic stroke among others. Identifying vulnerable subgroups by local regions will be essential for preventing heat-related mortality and morbidity.
Support development of public health planning tools for local communities	Preparing Public Health Officials for Climate Change: A decision support tool	This project will develop a decision support tool for public health officials using probabilistic short-and medium-term weather/climate forecasts designed to assist the public health sector with adapting to climate variability and change. Tool development will involve close collaboration with the California Department of Public Health , Office of Environmental Health Hazard Assessment (OEHHA), and local public health agencies, whose needs and preferences will be incorporated into design of this decision support tool. Proposed research. Agencies: CNRA, CDPH, OEHHA Source: California Fourth Assessment
	Healthy Planning Leadership Webinar Series	Nine webinars geared towards better understanding planning with a health lens. Two will focus on climate change and how to integrate healthy planning and mitigation and adaptation measures. Agency: OPR 2015-16

Improve Capacity of Communities to Prepare, Respond, and Recover from Climate-Related Health Risks – C O N T I N U E D

	INITIATIVES	SUMMARY
Support development of public health planning tools for local communities	General Plan Guidelines	Contain a section on Climate Change, Social Equity, Community Engagement, and Healthy Communities also has an online mapping tool which will look at social indicators that increase vulnerability. Of note, additional recommendations outside of elements required by statute are not mandatory. Agency: OPR 2015
	Indicators of Climate Change in California	Update of *Indicators of Climate Change in California*, scheduled for publication in 2017, by CalEPA Office of Environmental Health Hazard Assessment Agency: CalEPA-OEHHA 2015
	Integrated Transportation and Health Impacts Model (ITHIM)	The Integrated Transport and Health Impacts Model (ITHIM) is a tool to estimate the health co-benefits and potential harms from active transport and low carbon driving in urban populations. It showed that Increasing median daily walking and bicycling from 4 to 22 minutes in the San Francisco Bay Area reduced the burden of cardiovascular disease and diabetes by 14% (32,466 DALYs), increased the traffic injury burden by 39% (5907 DALYS), and decreased greenhouse gas emissions by 14%. Low-carbon driving reduced GHGE by 33.5% and cardiorespiratory disease burden by less than 1%. Virtually all (99%) of the health benefits were a result of increasing physical activity rather than from reductions in air pollution (shifting to low-carbon driving).
Healthy energy efficient buildings	Green Building Action Plan	Executive Order B-18-12 directs agencies and departments to green the state's buildings, reduce GHG emission and improve energy efficiency. All new and renovated state buildings larger than 10,000SF to achieve LEED Silver certification or higher, and to incorporate clean on-site power generation and clean back-up power supplies.
	CALGreen (Green Building Code)	California's Green Building Code (CALGreen, current code in effect is 2013 version). Provides requirements/options for constructing green buildings, including options to incorporate urban greening strategies, hardscape standards (e.g. lighter colored to absorb less heat), and cool roofs. Agency: Dept. of General Services / Building Standards Commission
	Green Building Research	The California Air Resources Board's (ARB) green building research agenda is focused on reducing GHG emissions while also avoiding any increases to other criteria pollutants that may affect public health. Research projects include looking at co-benefits of green buildings, residential energy use and GHG emissions impacts of compact land use types, and benefits of widespread deployment of cool roofs. Agency: California Air Resources Board

Improve Capacity of Communities to Prepare, Respond, and Recover from Climate-Related Health Risks – C O N T I N U E D

	INITIATIVES	SUMMARY
Healthy energy efficient buildings	Building Energy Efficiency Standards	Building Energy Efficiency Standards apply to new homes and commercial buildings, and offer builders better insulation, lighting, ventilation systems, and windows that will help to reduce energy use in homes and businesses. Agency: California Energy Commission
	Residential Energy Efficiency and Energy Assistance Programs	The Weatherization Assistance Program (WAP) is designed to help low-income individuals and families increase the energy efficiency of their homes for both rental or owned properties. The Low-Income Home Energy Assistance Program (LiHEAP) provides assistance to eligible low-income households to manage and meet immediate residential heating and/or cooling needs. Agency: Department of Community Services and Development The Energy Savings Assistance Program provides weatherization services at no cost to low-income households who meet California Alternate Rates for Energy (CARE) income guidelines. Agency: California Public Utilities Commission (CPUC)
Low allergen or non-allergenic urban greening	HiAP 2011-2015 Action Report: Support Urban and Community Greening and Access to Green Spaces	Report supports establishment of a baseline tree canopy inventory; develop / disseminate information (including role of vegetation in reducing exposures to near-road pollutants, and cooling public and private spaces) to non-traditional partners about the health, environmental, and economic co-benefits of parks, urban forestry, and urban and community greening (including role of vegetation in reducing exposures to near-road pollutants, as well as cooling public and private spaces). Current Agencies: SGC / HiAP, CAL FIRE, ARB, OPR
	Urban Forestry Program	Urban forestry and greening in cities and communities reduces heat island effects and carbon emissions. Promotes tools and research on allergens and co-benefits of urban greening, bio-roofs, landscaping impacts on health and community cohesion, mental health, and crime reduction. $16 million Cap & Trade funding in 2015. Agency: CAL FIRE

Better Understanding of Climate Impacts on Public Health

	INITIATIVES	SUMMARY
Local vulnerability assessment efforts to design and implement strategies to address local risks	CalEnviro Screen 2.0	CalEnviroScreen is a screening methodology that can be used to help identify California communities that are disproportionately burdened by multiple sources of pollution. Useful to determine where risks of toxic exposure could occur during flooding and sea level rise.
	CalBRACE	In collaboration with CDC and California local health departments, provides resources, technical assistance for State and local public health departments including downscaled vulnerability reports, technical assistance, funding and capacity building for the State and local public health departments. Years: 2012 – 2016 Agency: CDPH
	Cal-Adapt Web Portal	Website providing interactive maps and charts on various projected climate effects, including heat, precipitation, snowpack, sea level rise, and wildfire. Year: Current Agency: CEC
	California Statewide Plan to Promote Health and Mental Health Equity	Portrait of Promise: The California Statewide Plan to Promote Health and Mental Health Equity is a report to the legislature and the people of California by the Office of Health Equity. The plan includes actions to incorporate health equity into CDPH's and the state's climate action approach and collaboration across sectors. Year: 2015 Agency: CDPH
	CASPER (Community Assessment for Public Health Emergency Response) on health impacts of drought	In fall 2015 CDPH conducted one CASPER (Community Assessment for Public Health Emergency Response) in Mariposa and two in Tulare County, both hard-hit by the several-year drought. The results of this statistically valid survey of residents will identify health impacts of drought, and can inform action at the state and local levels to reduce and prevent health harms from drought.
Increase capacity to monitor climate-related deaths and illnesses	California Environmental Health Tracking Program	Provides data and information on diseases and environmental threats to inform environmental and public health programs, research, and policies. Includes climate change vulnerability maps. Year: 2002 (ongoing) Agency: CDPH
	Health Impacts from Wildfire Smoke Exposure Research	Research public health impact of wildfires: characterize increases in emergency room visits, hospitalizations, physician visits; identify spectrum of affected conditions; assess impact in vulnerable populations. Years: 2014 – 2016 Agency: CDPH
	California Mosquito-Borne Virus Surveillance and Response Plan	Plan provides guidelines and information on the surveillance and control of mosquito-borne viruses in California, prompts surveillance and control activities associated with virus transmission risk level, and provides local and state agencies with a decision support system. Year: 2015 Agency: CDPH

Better Understanding of Climate Impacts on Public Health – C O N T I N U E D

	INITIATIVES	SUMMARY
Increase capacity to monitor climate-related deaths and illnesses	Binational Border Infectious Disease Epidemiology Program	The Office of Binational Border Health is engaged in ongoing communication with the Epidemiology Department in the state of Baja California, Mexico, to enhance situational awareness regarding vector-borne diseases on both sides of the border. Year: Current 2015 Agency: CDPH
Social vulnerability mapping for climate change	CalBRACE VA Mapping for California Counties & state	County level and state reports that highlights the susceptibility of various vulnerable populations to the impacts of climate change. Year: 2015 Agency: CEC, CNRA
Regional Studies of Aero-allergens		No action identified on this recommendation.

Information Sharing and Education

	INITIATIVES	SUMMARY
Raise awareness and foster action to address climate risks to public heath	Climate Action Team - Public Health Working Group	Climate Action Team - Public Health Working Group meets quarterly for sharing information on climate and health-related topics; webcast and archived presentations, and also works across sectors on deliverables to address climate impacts on human health. Year: 2009 (ongoing)　　　Agency: CDPH, ARB
	CalBRACE Local Public Health Partnership	Provides opportunities for county health departments to collaborate and share resources. Held 2-day workshop in September 2015. Local Public Health Partnership community of practice, an online collaboration tool. Year: 2012 – 2016　　　Agency: CDPH, CDC
	Update of Guidelines for General Plans	A Public Health Workgroup convened by Health in Policies staff provided input into the update for the general plan guidance adding more emphasis on adaptation and social determinants of health to reduce vulnerability to climate change impacts to public health. Year: 2015　　　Agency: OPR – CDPH
	Public Health Emergency Preparedness Training Workshop	Partially funded through CDC Public Health Preparedness Program; Workshop provides opportunities to share best practices for building emergency preparedness and response capacity. 2015 Workshop featured panel on impacts of the drought and climate change on public health. Year: 2015 (Annual)　　　Agency: CDPH
Public education on how to reduce and prepare for climate health risks	California Department of Health Website	CDPH web site: Office of Health Equity - Climate and Health and California Environmental Health Tracking Portal provide an entry point to resources on climate change and public health in California. Summarizes mitigation and adaptation tools, educational materials, and climate and health communications resources. Tracking Program provides background on exposures and research. Year: Current 2015　　　Agency: CDPH
	OutsideIn SLO Pilot Project Communication - San Luis Obispo	A 2014-2015 Public Health –climate change awareness and prevention campaign piloted in San Luis Obispo County by CDPH and San Luis Obispo County Public Health Department, and partners. Year: Current 2015　Agency: CDPH

Information Sharing and Education – C O N T I N U E D

	INITIATIVES	SUMMARY
Public education on how to reduce and prepare for climate health risks	Public Health and Emergency Preparedness Training Series for Latino Community- serving Organizations	Quarterly trainings on Emergency Preparedness with community leaders and organizations that serve the San Diego County Latino population. Content includes all hazards preparedness, emergency preparedness tools and resources, best practices on reaching vulnerable populations, and more. Year: Current 2015 Agency: CDPH
	Cool your School	Cool Your School is a series of 6th-grade, classroom-based, science activities rooted in Berkeley Lab's cool-surface and cool materials research and aligned with California science content standards. Run by Berkeley Labs, Supported by OPR

APPENDIX C: METRICS FOR CLIMATE CHANGE AND RESILIENCE MONITORING

The chart below compares metrics from a sample of the screening methods used to assess vulnerability and resilience to environmental exposures including climate change.

Over the long-term, success at increasing community resilience to climate change health impacts depends on changing the structural, social and economic drivers discussed in the beginning of the Public Health chapter that impact living conditions and ultimately health inequities that include heightened vulnerability to climate impacts. The Healthy Communities Data and Indicator Project (HCI) at the CDPH Office of Health Equity provides data at the county, town or census tract level that help measure to what degree a community provides the characteristics of a healthy community.(48) The National Association for the Advancement of Colored People's publication, *Equity in Building Resilience in Adaptation Planning* offers an extensive list of metrics, some of which are included here, for preexisting vulnerabilities, assets that shape a healthy community, and indicators of actions taken to increase resilience.(49)

Other indicators in this list track exposure to toxins, which are often released in conjunction with greenhouse gases or harm health, thus impacting vulnerability. Still other indicators track health conditions that can increase vulnerability, environmental conditions that can harm health or are affected by climate change, and demographic characteristics that may affect resilience.

This table is presented to facilitate collaboration among creators of different tools, as well as users of the tools, and to bring the interests of environmental justice advocates together with those of health equity advocates, in their mutual pursuit of health equity and environmental justice. These indicators can also serve to measure progress towards (a) reducing exposure to toxins among vulnerable populations, (b) reducing underlying vulnerabilities in populations, and (c) actions taken to mitigate climate change and build community resilience.

The chart developed by Rachel Morello Frosch for an Environmental Justice Screening Method Webinar, Wednesday, May 13, 2015 was the prototype that was adapted and expanded for this chart: https://dornsife.usc.edu/assets/sites/242/docs/Screening_Methods_Comparison_v2.pdf .

Due to space limitations, not all indicators from each source are included in this chart.

Key to abbreviations:

EJSM = Environmental Justice Screening Method(50)

OEHHA = Office of Environmental Health Hazard Assessment Indicators of Climate Change in CA(51)

CEVA = Cumulative Environmental Vulnerabilities Assessment(52)

HCI = Healthy Community Indicators(53)

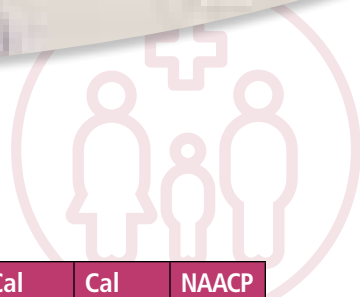CalBRACE = CalBRACE Vulnerability Indicators(54)

CES 2.0 = CalEnviroScreen 2.0(55)

NAACP = National Association for the Advancement of Colored Peoples Resilience Indicators(49)
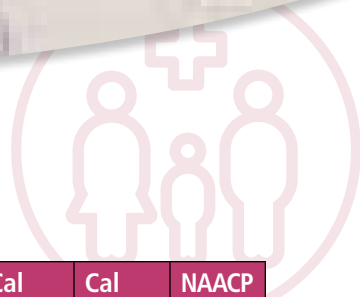
INDICATORS	EJSM	OEHHA	CEVA	HCI	Cal BRACE	Cal ES 2.0	NAACP
Hazard Proximity Metrics - Sensitive Land Uses/Areas							
Childcare facilities	X						
Healthcare facilities	X		X				
Schools	X						X
Urban Parks Playgrounds / Beach, Coast or Open space, % live within ½	X			X			
Senior Residential	X						
Rural areas					X		
Nursing facilities, prisons, college dorms					X		
Hazard Proximity Metrics - Polluting Facilities/Land Uses							
CARB Facilities of Interest (FOI) (air toxics and GHG emissions facilities)	X						
Industry-wide facilities (auto paint/body, gas stations)	X						
Hazardous/solid waste facilities, cleanup sites	X		X			X	X
Railroads	X					X	
Ports	X					X	
Refineries	X		X				
Intermodal distribution facilities	X						
Traffic exposure	X					X	
Chrome plating facilities (FOI)	X		X				
Cleanup sites (EnviroStor)			X			X	
Solid waste (FOI)	X		X			X	
Groundwater threats from leaking underground storage sites and cleanups (GeoTracker)			X			X	
Impaired water bodies			X			X	
Adequate /effective sewage/waste management systems							X
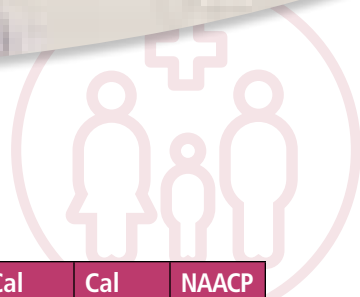
INDICATORS	EJSM	OEHHA	CEVA	HCI	Cal BRACE	Cal ES 2.0	NAACP RES
Health Risk and Exposure Metrics							
Risk Screening Environmental Indicators	X					X	
National Air Toxics Assessment – cancer risk	X						
National Air Toxics Assessment – respiratory hazard	X		X				
Toxic releases from facilities						X	
PM2.5 (interpolated from CARB monitors)	X			X	X	X	X
Ozone (interpolated from CARB monitors)	X		X	X	X	X	X
Diesel PM emissions- *DPM emissions data are folded into the NATA cancer risk data.*	X					X	
Black carbon concentration		X					
Pesticide exposure	X		X			X	
Water quality – contaminants	X		X	X		X	
Water quality – source vulnerability	X						
Impaired water bodies			X			X	
Mosquito-borne diseases		X					
Heat-related mortality and morbidity		X					
Heat-related emergency room visits					X		
Urban heat islands		X					
Social and Health Vulnerability Metrics							
Race/ethnicity	X		X		X		X
Poverty level	X		X	X	X	X	X
Educational attainment	X		X	X	X	X	X
Age (<5 and >64)	X		X		X	X	X
Gender / Sexual orientation							X
Linguistic isolation or ESL	X		X		X	X	X
Unemployment			X	X		X	X
Homeless persons							X
Undocumented persons							
Renters/home ownership	X		X				X
Median house value	X						
Housing Cost Burden- Households paying> 30% (or 50%) income on housing				X	X		
Household overcrowding					X		
Voter participation	X				X		X

INDICATORS	EJSM	OEHHA	CEVA	HCI	Cal BRACE	Cal ES 2.0	NAACP RES
Social and Health Vulnerability Metrics (continued)							
Public Transit Access, % Live within ½ mile				X	X		X
Low birth weight and/or SGA	X		X			X	
Asthma hospitalization (0-19 years)			X				
Asthma diagnosis ever/ Asthma emergency room visits					X	X	
Elderly living alone	X						
Auto ownership	X				X		X
Air conditioning ownership					X		
Living Wage % families				X			X
Health insurance coverage					X		X
Mental disability					X		X
Physical disability					X		X
Adults with multiple chronic conditions					X		
Annual ED visits related to heat							
Adult obesity					X		
Persons with pre-existing health conditions							X
Work outdoors					X		
Food Affordability				X			
Food insecurity					X	X	
Access to Healthy Foods				X			X
Age-adjusted death rate by race and ethnicity					X		
Violent crime					X		X
Years of potential life lost before age 65			X				
Climate Vulnerability Metrics							
Tree canopy	X				X		
Impervious surfaces	X				X		
Projected temperature, observed temperature or temperature changes	X	X			X		
Projected increase in warm nights	X						
Extreme heat events		X			X		
Precipitation		X					
Sierra Nevada snowmelt runoff		X					
Snow-water content		X					

INDICATORS	EJSM	OEHHA	CEVA	HCI	Cal BRACE	Cal ES 2.0	NAACP RES
Climate Vulnerability Metrics (continued)							
Wildfire		X			X		
Ocean acidification		X					
Winter chill		X					
Sea level rise and flood risk		X			X		
Adaptive Capacity Process/Outcome Metrics							
Adaptation specific planning/decision making							X
Public health sector adaptation specific planning/decision making							
Health and human services sector adaptation specific planning/decision making							
Equity based resource allocation							X
Inclusive stakeholder engagement in adaptation/ resilience planning							X
Flood control measures							X
Coastal/shoreline restoration projects (mapping/ distribution)							X
Solar and Wind installations (mapping/distribution)							X
Storm water management projects							X
Cooling Centers							X
Early Warning Systems							X
Gender responsive emergency management plans							X
Property value increased or decreased							X
Schools temporarily/ permanently closed							X
Homes damaged/flooded/destroyed							X
Residents returning /rebuilding							X
Renters/ homeowners displaced (temporarily and permanently)							X
Crops lost/farms lost due to drought/flooding/other climate hazards							X
Emergency Child Care Centers							X
Sheltering provisions for LGBTQ persons							X
Laws/ordinances to prevent gentrification/displacement							X
Community/health impact reports for redevelopment projects							X
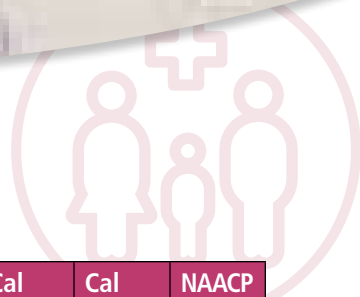
INDICATORS	EJSM	OEHHA	CEVA	HCI	Cal BRACE	Cal ES 2.0	NAACP RES
Adaptive Capacity Process/Outcome Metrics (continued)							
Culture shift as result of disaster/displacement/ agriculture yields, etc.							X
Community benefits /workers agreements for new developments							X
Local community farms/gardens							X
Jobs lost temporarily (temporarily and permanently)							X
New Jobs created (temporarily and permanently)							X
Business owners/businesses returning /rebuilding on same site							X
Local hires for infrastructure projects (storm water, solar, waste water, etc)							X
Health care/mental health care services and facilities							X
Sufficient interpretation/language access to matches populace							X

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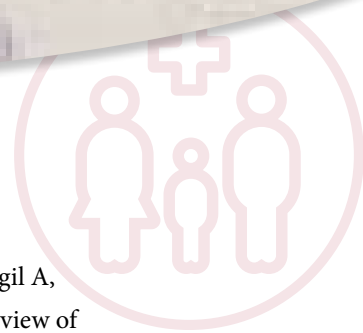
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