Adapting to Extreme Heat in California:

Assessing Gaps in State-Level Policies and Funding Opportunities

UCLA Luskin Center for Innovation

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Contents

Executive Summary

DUE TO CLIMATE CHANGE, Californians are experiencing higher average temperatures and should expect more frequent and severe heat waves in coming decades. A now well-established body of research demonstrates that heat exposure has diverse and damaging impacts. Our physical and mental health suffers in a myriad of acute and chronic ways. Students learn less. Workers experience more accidents. Climate-exposed workers earn less income. Households pay more to cool their homes or have their electricity shutoff because they can't pay. California will increasingly need to regulate heat exposure to avoid these mounting health, economic, and social damages.

In this work we aim to outline state-level regulations, funding opportunities, and planning efforts that exist to address the issue of extreme heat in selected settings in California, and to understand which state entities have oversight of selected activities. This assessment furthers an understanding of ongoing efforts and where there are policy gaps that should be filled to protect individuals and communities from adverse heat-related impacts. We hope this assessment will move the State of California toward a more

comprehensive and robust framework to address the issue of heat throughout the state and to fund heat risk-reducing measures.

This assessment is based on a review of existing regulations and heat-relevant funding opportunities; for the latter, this report focused on funding opportunities that existed as of the first quarter of 2021. As of October 2021, the state budget includes $800 million in funds to address extreme heat between 2022 and 2024. These funds will be used for a new community resilience and heat grant program that will be developed, in addition to other activities, to be determined. We hope this assessment will helpful for illuminating existing gaps in protective policies that could be filled in part, utilizing this funding as well as through future heat adaptation efforts in the state.

Policy assessments for priority exposure settings

We focus our analysis on seven priority settings for heat exposure: 1) Homes; 2) Workplaces; 3) Schools and Child Care Facilities; 4) Senior Assisted Living Facilities; 5) Prisons, Jails, and Correctional Facilities; 6) Public Outdoor Spaces (i.e., Parks, Recreation Spaces); 7) Public Transit Stops.

For each of these exposure settings, we undertake an in-depth assessment of the status of heat policies and funding opportunities that can reduce the risks associated with heat. We do so by:

1) Describing a set of possible heat risk-reducing interventions for each exposure setting;
2) Identifying the state decision-maker with oversight regulating activities and/or selected interventions in this setting;
3) Determining whether state laws or regulations exist for regulating the thermal conditions of this setting, noting whether these are: a) thermally focused technology standards; b) behavioral guidelines; or c) thermal performance standards.[1] Where such regulations exist, we note which public agency has responsibility for designing, adopting, implementing, monitoring compliance, and enforcing these regulations;
4) Analyzing whether there are state-level funding opportunities to implement heat risk-reducing interventions for the setting (as of the first quarter of 2021); and
5) Assessing the degree to which these funding opportunities recognize heat risk-reduction as a priority objective and seek to actively target program delivery to heat-vulnerable places throughout the state.

Based on our assessment of these seven critical settings for heat exposure. we find that:

1. **There is no centrally responsible authority to provide technical assistance, strategic funding, or coordination to sister agencies to address the issue of heat.**

   Authority for the regulation of extreme heat exposure is fragmented across numerous state agencies, which have setting-specific authority. These include the Division of Occupational Safety and Health (Cal/OSHA), Department of Social Services, Department of General Services, Department of Education, the Department of Public Health, and the Office of Emergency Services, among others.

[1] ***Technology standards*** require the presence of thermal-regulating technology such as a shade structure, a cooldown area, or an air conditioner. ***Behavioral guidelines*** required that people take specific averting, protective, or mitigating actions such taking breaks, wearing protective equipment/clothing, and work stoppages when temperatures exceed specified thresholds. ***Performance standards*** require that an exposure setting be thermally regulated to ensure temperatures do not exceed specific thresholds, e.g., assisted living facilities should not exceed X degrees Fahrenheit.

Consolidating statutory authority for heat risk regulation and resiliency investment across these settings into one agency is not likely to be desirable. However, the state does need a single authority that:

a) supports its sister agencies with research on the impacts of heat exposure;
b) supports the development and design of heat risk-reduction policies within these agencies across distinct exposure settings;
c) leverages the executive branch's authority to ensure interagency coordination;
d) promotes public education across distinct exposure settings; and
e) administers funding for unique heat risk-reduction investments that cannot or should not be channeled through sister agencies' funding pathways.

2. Most existing heat-exposure standards are inadequate or have limited compliance reporting.

Not all settings have heat risk-reducing regulations in place and where regulations do exist, there is often limited reporting on compliance and enforcement. We find that the exposure settings fall into three categories:

Exposure settings with no regulation. There are neither technology nor performance heat standards for several key settings, including the residential setting, public schools, prisons and correctional facilities, and transit wait stops for transit users. These settings are often occupied by individuals who are vulnerable to heat risks (e.g., youth, older adults) and/or poor health outcomes (e.g., incarcerated individuals with limited agency in correctional facilities). Although California building codes require that settings intended for human occupancy be equipped with active or passive heating systems so that the space can be kept sufficiently *warm*,[2] there are no such requirements to ensure that indoor spaces can be made sufficiently *cool* for users.

Recent and emerging regulations for workplace settings. For outdoor workplaces, Cal/OSHA has a mandatory heat-illness prevention rule involving technology requirements (e.g., shade and water provision) as well as behavioral requirements (work breaks, heat-illness prevention training and protocols). An indoor heat-illness prevention rule that was slated to be promulgated in 2019 is still in draft form. It blends key performance standards that would require employers to provide access to water and cooldown areas, maintain close observation of employees, and maintain emergency response procedures when indoor temperatures exceed 82 degrees. It would also require additional heat illness-prevention measures when the temperature or heat index exceeds 87 degrees.[3]

Settings with performance standards but limited monitoring reporting. The State of California has performance-based standards that are designed to limit heat exposure in assisted living facilities for older adults and daycare facilities for children. However, the extent of consistent compliance with these regulations is unclear. While regular facility inspections are required,

[2] California Code of Regulations, Title 24, Part 2, Section 1203.1
[3] Or if the temperature reaches 82 degrees in a workplace where employees wear restricting clothing or work in areas with high radiant heat.

temperature readings from sites are not consistently recorded in inspection reports. [4]

3. **Most existing state programs do not make investments that explicitly target heat- vulnerable places or quantify heat risk-reduction benefits.**

   We reviewed over 20 programs[5] overseen by 10 different state agencies that do channel funding for heat-relevant measures[6] into several of the priority settings we identified. We were not able to identify a state investment program whose *primary* objective is heat risk-reduction.[7] While programs such as the Urban Greening Program or the Low-Income Weatherization Program can provide benefits such as improved thermal comfort, their primary goals based on program guidelines are greenhouse gas emissions reductions. Increased shade and/or other thermal benefits are considered co-benefits. In addition, there was no program that allocated investments based on anticipated climate conditions (e.g., projected temperatures, extreme heat days or events). CalEnviroScreen, which is broadly used by many agencies to allocate funding, does not recognize or incorporate extreme heat risks. A few programs recognize heat-related co-benefits that could be created by the program (e.g., reducing urban heat island effect); however, there seemed to be no evaluation mechanism or requirement to understand the effect of these investments on addressing heat. Only two programs, the Low Income Home Energy Assistance Program and the Weatherization Assistance Program, used a heat-relevant metric (historic cooling degree days) to inform funding allocation decisions for weatherization services and energy bill pay assistance.

4. **Local hazard planning efforts may not be preparing cities adequately for extreme heat.**

   By 2022, state laws (SB 379, SB 1035) require that local governments update the safety elements of their general plans to address climate adaptation and resiliency needs. These plans should respond to climate impacts, including increased heat exposure. Some heat-related guidance documentation does exist to support these planning processes. While general plan updates is a helpful first step toward understanding climate hazards in a region, the implementation of heat-reduction strategies will require further investments for training, staff capacity, and funding to implement interventions. Without dedicated state financing assistance, similar planning mandates have led to inequalities in governance capacity as better-resourced communities are more likely to train staff, plan and coordinate across collaborating agencies than lower-income communities.

5. **Improving thermal comfort in public spaces and reducing urban heat island effects rely largely on voluntary state guidance.**

   The most recent version of the California Building Energy Efficiency Standards (2019) includes requirements around the

[4] California Department of Social Services Community Care Licensing Division. (n.d.). *Search by Facility Group.* https://www.ccld.dss.ca.gov/carefacilitysearch/

[5] We reviewed programs that were offered in 2020 or were available through the first quarter of 2021.

[6] Home weatherization, urban greening, solar PV, cool roofs, shade structures, air-conditioning replacement or repair, planning efforts to address extreme heat, or utility bill pay assistance

[7] The Heat Illness Prevention safety program overseen by Cal/OSHA is an exception in that its primary focus is heat illness prevention through education around and enforcement of the outdoor Heat Illness Prevention Standard; it does not, however, provide direct funding opportunities for workplaces to mitigate heat or address heat-related risks.

use of cool roofing materials. However, these are only for newly constructed buildings, building retrofits, or building additions. The CalGreenCode includes various other measures to reduce the urban heat island effect — the phenomenon in which urban regions are hotter than their rural counterparts due to heat retention and production by the built environment. Such measures include the use of trees to provide shade and high-albedo materials, and locating parking underground or building multilevel parking, among other measures in residential and nonresidential buildings that may be considered and adopted by local jurisdictions. However, it is important to note that these are *voluntary* measures. Absent readily accessible state financ

ing assistance designed to address the issue of thermal comfort and extreme heat, such voluntary standards are unlikely to be adopted in moderate and low-income communities in the near future. This is of particular concern as these communities often have less green space and tree canopy per capita as well as higher percentages of low-income residents reliant on public transit, making them more vulnerable to adverse heat impacts.

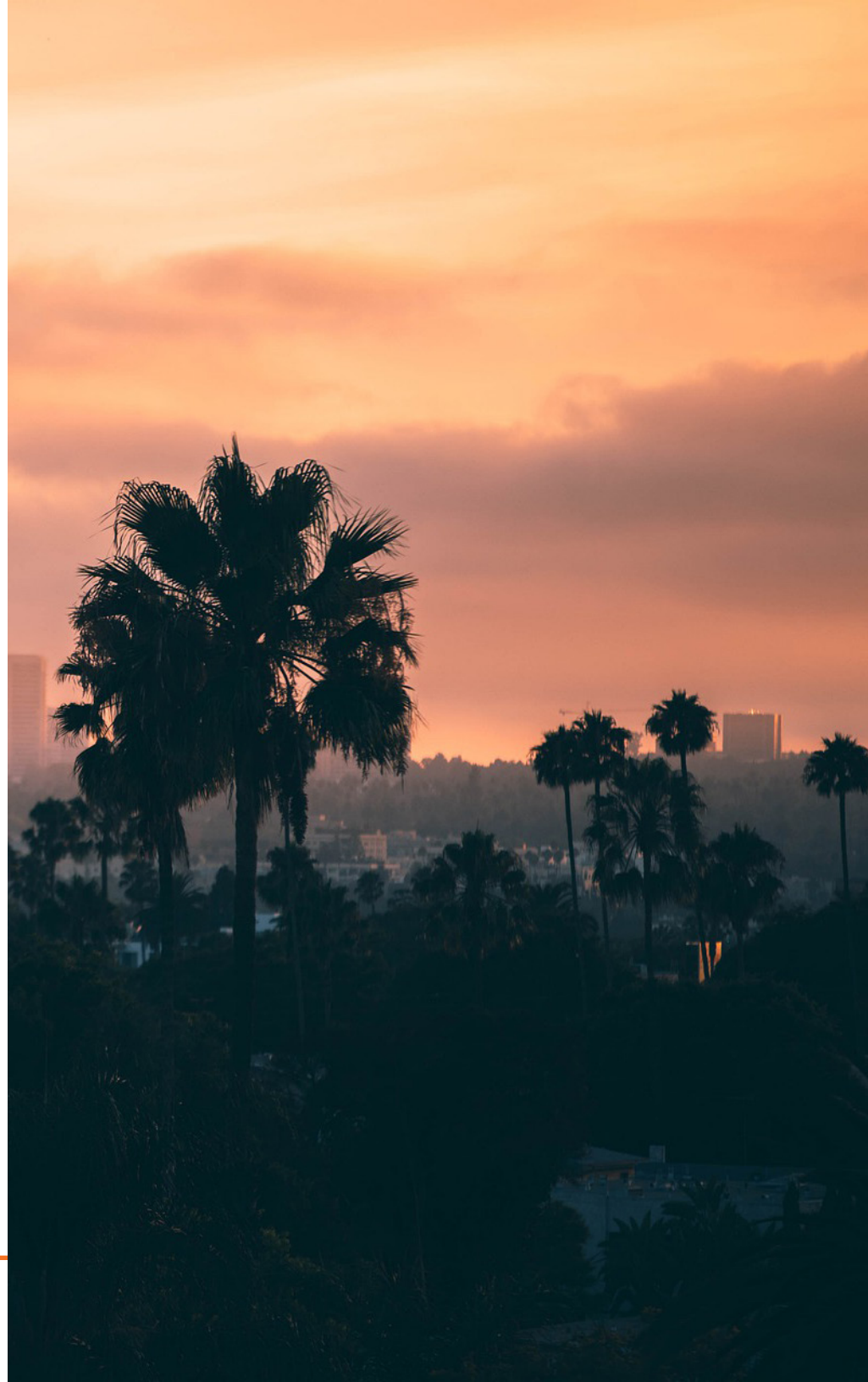
We hope our assessments of these gaps and limitations in current policies and organizational capacity can guide future policy development, legislative action, and research activities.

Chapter 1: Introduction

CALIFORNIA IS FORECAST TO EXPERIENCE hotter average temperatures as well as longer and more frequent heat waves over the coming decades due to climate change. A growing body of research shows that this heat exposure will likely have large and increasing health, social, and financial costs. These costs may be substantially reduced through policies that lower the risk of adverse heat-related impacts. This report offers an overview of state-level regulations, planning efforts, and funding opportunities that exist to address the issue of extreme heat in selected settings in California, and state entities that have oversight of these activities. We hope that this work is a helpful step toward understanding ongoing efforts and where there are policy gaps that could be filled to protect Californians from adverse heat impacts.

Public governance of specific heat-exposure settings

We begin by focusing on the specific settings or places where people may be exposed to extreme heat. In Chapter 2, we identify exposure settings based on places where 1) the general population spends their time on a typical day and 2) where especially heat-vulnerable populations such as older adults, youth, and infants spend much of their time. We identify the following seven focal settings for the analysis by using an assessment of the American Time Use Survey as well as a review of literature to identify heat-vulnerable populations: 1) Homes; 2) Workplaces; 3) Schools and Child Care Facilities; 4) Senior Assisted Living Facilities; 5) Prisons, Jails, and Correctional Facilities; 6) Public Outdoor Spaces (i.e., Parks, Recreation Spaces); 7) Public Transit Stops.



In Chapters 3 to 9, we assess what heat risk-reducing policies and programs exist for each of these seven exposure settings. To do this, we identify the heat risk-reducing interventions that can be taken in the setting and the decision-maker who is, or could be, responsible for implementing that intervention. We then describe whether that decision-maker is subject to any heat exposure regulations, noting whether these are a) thermally focused technology standards, b) behavioral guidelines, or c) thermal performance standards.[1] Where such regulations exist, we note which state agency has responsibility for designing, adopting, implementing, monitoring compliance, and enforcing these regulations.

For each exposure setting, we also analyze whether state-level programs that provide funding opportunities for each heat risk-reducing intervention exist. We conclude with a discussion on the degree to which these programs recognize heat risk reduction as a priority objective and seek to actively target program delivery to heat-vulnerable places throughout the state.

By carefully assessing each of these critical exposure settings we began to construct a more holistic description of the current state of California-wide heat risk-reduction programs and policies.

Assessing state guidance and support of local government efforts

Our setting-specific analyses reveal that both state and local governments have oversight over different heat exposure-related regulations and interventions but that their relative responsibilities vary significantly across settings. We describe state efforts in Chapter 10 to better adapt these local policies to future climate impacts, including extreme heat. In Chapter 11, we describe the extent to which state agencies currently support local governments during heat emergencies (i.e., “heat waves”).

We conclude in Chapter 12 by reflecting on crosscutting questions about governance capacity and policy gaps. Looking across settings we ask: Where do heat risk-management regulations exist? And we evaluate where there is potential for integrating the objective of heat risk-reductions into existing programs and policies that could reduce exposure in critical settings.

Limits of this report

By design, this report focuses only on state-level regulations, funding opportunities, and responsibilities of state agencies to address the issue of heat. We do not examine the current governance capacity and policy gaps associated with local and regional governments. Yet, as our analysis of the seven exposure settings reveals, local governments are likely to share in governance of many critical exposure settings such homes and workplaces, particularly given their oversight of local building codes that can influence the thermal conditions of these spaces. Moreover, for some exposure settings, such as public parks, sidewalks, and public transit stops, local governments are likely to lead policy developments. Thus, additional efforts to examine local and regional policy gaps for heat risk management would be useful.

[1] ***Technology standards*** require the presence of thermal-regulating technology such as a shade structure, a cooldown area, or an air conditioner. ***Behavioral guidelines*** required that people take specific averting, protective, or mitigating actions such taking breaks, wearing protective equipment/clothing, and work stoppages when temperatures exceed specified thresholds. ***Performance standards*** require that an exposure setting be thermally regulated to ensure temperatures do not exceed specific thresholds such assisted living facilities should not exceed X degrees Fahrenheit.

Chapter 2: The Need for Heat Risk-Management Policies in Common Exposure Settings

THE OBJECTIVE OF THIS CHAPTER is to motivate the need for heat risk-management policies in common exposure settings. We begin by briefly describing expected increases in heat exposure in California during the decades to come. We then summarize the growing body of literature on various types of health, financial and physical harms, and damage that results from heat exposure. We describe at a general level the various types of interventions and measures that could be adopted that either 1) mitigate heat; 2) protect individuals and communities from heat exposure; and/or 3) reduce adverse financial impacts at the household level stemming from increased energy use during high-heat periods. We conclude this chapter by presenting and justifying a set of common and important exposure settings around which we organize our analyses for the remainder of this report.

Temperatures forecast to rise sharply in california

The State of California is anticipated to experience increases in temperature. According to California's Fourth Assessment, the state will experience average daily high temperatures that are approximately 5.8F warmer than the historical average over the period 2040–2069 if greenhouse gas emissions continue at current rates. This increase is approximated to be 8.8F over the period 2070–2100.[1]

Certain geographical factors will cause temperatures above these forecast averages. One factor is the nature of the built environment. Urban regions can experience above-average high temperatures due to the urban heat island (UHI) effect, which is caused by increased heat absorption by low albedo (nonreflective) materials in the built environment such as asphalt, concrete, and dark rooftops; reduced vegetation in urban regions; and reduced airflow from higher building density. [2]

A second factor is the geographical location. Across California, heat impacts are forecast to be higher than average in inland and Southern California areas. For example, selected counties that are anticipated to see the highest number of extreme heat days per year over their 98th historical percentile (1961–1990 between April and October) from 2040 to 2060 include: Tulare (41.8 projected number of days), Inyo (41.1), Mono (40.2), Fresno (38.8), San Bernardino (37.7), Madera (37.3), Riverside (37.3), Imperial (37.1), Kern (35.3), and Mariposa (35.3).[3]

The anticipated impacts of extreme heat

Rising temperatures will have wide-ranging impacts on public health, energy use, risks of wildfire, infrastructure safety and reliability, water supplies, agricultural outputs, worker productivity, youth learning, and more. Examples of heat impacts are detailed below.[4]

Health: Excess heat exposure can lead to heat illnesses such as heat cramps, heat rashes, heat exhaustion, and heat stroke.[5] It can induce or exacerbate illnesses related to cardiovascular,[6] respiratory,[7] mental, and renal health; it can impact the efficacy of medications that require cold storage such as insulin, amplifying the risks borne by those with preexisting health conditions. Beyond direct health impacts from elevated exposure to heat, higher temperatures can lead to a proliferation of pests and vector-borne diseases (e.g., West Nile virus), as well as infectious diseases such

[1] California Natural Resources Agency. (2018). *California's Changing Climate 2018: A Summary of Key Findings from California's Fourth Climate Change Assessment*. https://www.energy.ca.gov/sites/default/files/2019-11/20180827_Summary_Brochure_ADA.pdf

[2] California Environmental Protection Agency (2021). *Urban Heat Island Index for California.* https://calepa.ca.gov/climate/urban-heat-island-index-for-california/

[3] California Department of Public Health. (n.d.). *Welcome to the CCHVIz.* Retrieved December 2020 from https://skylab.cdph.ca.gov/CCHVIz/

[4] U.S. Environmental Protection Agency. (n.d.). *Heat Island Impacts.* https://www.epa.gov/heatislands/heat-island-impacts

[5] Centers for Disease Control and Prevention. (2017). *Warning Signs and Symptoms of Heat-Related Illness.* https://www.cdc.gov/disasters/extremeheat/warning.html

[6] Liu, C., Yavar, Z., & Sun, Q. (2015). Cardiovascular response to thermoregulatory challenges. *American Journal of Physiology-Heart and Circulatory Physiology*, *309*(11), H1793-H1812.

[7] Anderson, G. B., Dominici, F., Wang, Y., McCormack, M. C., Bell, M. L., & Peng, R. D. (2013). Heat-related emergency hospitalizations for respiratory diseases in the Medicare population. *American journal of respiratory and critical care medicine*, *187*(10), 1098-1103.

as "valley fever."[8, 9] It can also increase the risk of food spoilage, food poisoning, and rates of food safety violations. In addition, crime, domestic violence, and road rage have also been shown to be associated with high heat periods.[10]

Energy: High temperatures increase electricity usage via air conditioning use and can consequently elevate utility bill costs for customers as well as the risk of power outages.[11]

Youth and Learning: Recent studies have shown that high temperatures can affect youth in schools by impairing academic performance and cognitive skill development.[12]

Wildfire: An increase in temperature results in drier conditions and the potential for drought. The frequency of large wildfires and the duration of the fire season have increased in the last few decades.[13, 14] In California, these conditions severely affect the North Coast and Sierra Nevada regions.[15]

Infrastructure and Transit: Heat can compromise infrastructure safety and reliability; it can cause issues such as train track buckling and road material softening.[16, 17] High temperatures can also prevent aircraft from taking off as it reduces the density of air mass, making it more difficult for aircraft to lift in addition to possibly softening tarmac materials.

Water: Higher temperatures can reduce the water supply in California from reduced precipitation and snowpack and earlier snowmelt.[18] Greater demand for water is also anticipated.[19, 20] Heat can also

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[8] James, S. J., & James, C. J. F. R. I. (2010). The food cold-chain and climate change. *Food Research International*, *43*(7), 1944-1956.

[9] Dominianni, C., Lane, K., Ahmed, M., Johnson, S., McKELVEY, W. E. N. D. Y., & Ito, K. (2018). Hot weather impacts on New York City restaurant food safety violations and operations. *Journal of food protection*, *81*(7), 1048-1054.

[10] Zuo, J., Pullen, S., Palmer, J., Bennetts, H., Chileshe, N., & Ma, T. (2015). Impacts of heat waves and corresponding measures: a review. *Journal of Cleaner Production*, *92*, 1-12.

[11] Miller, N. L., Hayhoe, K., Jin, J., & Auffhammer, M. (2008). Climate, extreme heat, and electricity demand in California. *Journal of Applied Meteorology and Climatology*, *47*(6), 1834-1844.

[12] Park, R. J., Goodman, J., Hurwitz, M., & Smith, J. (2020). Heat and learning. *American Economic Journal: Economic Policy*, *12*(2), 306-39.

[13] Peterson, T. C., Karl, T. R., Kossin, J. P., Kunkel, K. E., Lawrimore, J. H., McMahon, J. R., ... & Yin, X. (2014). Changes in weather and climate extremes: State of knowledge relevant to air and water quality in the United States. *Journal of the Air & Waste Management Association*, *64*(2), 184-197.

[14] California Natural Resources Agency. (2018). *Safeguarding California Plan: 2018 Update.* https://resources.ca.gov/CNRALegacyFiles/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

[15] Williams, A. P., Abatzoglou, J. T., Gershunov, A., Guzman- Morales, J., Bishop, D. A., Balch, J. K., & Lettenmaier, D. P. (2019). Observed impacts of anthropogenic climate change on wildfire in California. *Earth's Future*, *7*(8), 892-910.

[16] Clark, S. S., Chester, M. V., Seager, T. P., & Eisenberg, D. A. (2019). The vulnerability of interdependent urban infrastructure systems to climate change: Could Phoenix experience a Katrina of extreme heat?. *Sustainable and Resilient Infrastructure*, *4*(1), 21-35.

[17] Markolf, S. A., Hoehne, C., Fraser, A., Chester, M. V., & Underwood, B. S. (2019). Transportation resilience to climate change and extreme weather events–Beyond risk and robustness. *Transport policy*, *74*, 174-186.

[18] U.S. Environmental Protection Agency. (2016). *What Climate Change Means for California.* https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ca.pdf

[19] U.S. Environmental Protection Agency. (2016). *Climate Impacts on Water Resources.* https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-water-resources_.html

[20] California Natural Resources Agency. (2018). *Safeguarding California Plan: 2018 Update.* https://resources.ca.gov/CNRALegacyFiles/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

affect the reliability of water system infrastructure and operations.[21]

Agriculture: Increased temperatures and the corresponding decrease in winter chill hours can severely affect the successful production of California's crops, including fruit and nuts.[22, 23, 24, 25]

Workplace Safety and Productivity: Exposure to high temperatures may affect worker safety by increasing rates of workplace injuries;[26] it may also affect the performance and productivity of workers.[27]

Intersectional Effects of Heat Exposure: Many adverse heat impacts are interconnected and can create cascading effects. Increases in heat-related illnesses can lead to increased hospital emergency department visits, which could lead to slower treatment and response times to patients in need, further elevating risks for those suffering from heat-related illnesses. In the context of urban infrastructure systems, cascading impacts can result from extreme heat stress applied on interdependent water, power, and transportation systems.[28] While there is a wide spectrum of heat impacts, this report focuses primarily on the impact of heat on human health, as well as financial impacts from elevated utility costs.

Table 1: Examples of Heat Risk-Reducing Interventions

Heat Impact	Intervention Type	Example Interventions
Health	Building-level built environment interventions to reduce ambient temperatures	Weatherization; cool roofs; solar PV; air conditioning
	Community-scale built environment interventions to reduce ambient temperatures	Urban greening; shade and shade structures; cool streets; urban design / morphology
	Behavioral interventions to reduce health impacts associated with heat emergencies	Dissemination of preventative information and education; creation/ operation of cooling centers; direct outreach to vulnerable populations; setting and implementation of heat alerts, standards, and/or guidelines (e.g., in schools)
Financial	Financial interventions to reduce adverse financial impacts associated with increased energy use	Utility bill payment assistance

[21] California Department of Water Resources. (n.d.). *Climate Change Basics.* https://water.ca.gov/Water-Basics/Climate-Change-Basics

[22] Luedeling, E., Zhang, M., & Girvetz, E. H. (2009). Climatic changes lead to declining winter chill for fruit and nut trees in California during 1950–2099. *PloS one*, *4*(7), e6166.

[23] Department of Food and Agriculture. (2017). *California Agriculture Production Statistics.* http://www.cdfa.ca.gov/Statistics/

[24] Hatfield, J. L., & Prueger, J. H. (2015). Temperature extremes: Effect on plant growth and development. *Weather and climate extremes*, *10*, 4-10.

[25] California Natural Resources Agency. (2018). *Safeguarding California Plan: 2018 Update.* https://resources.ca.gov/CNRALegacyFiles/docs/climate/safeguarding/update2018/safeguarding-california-plan-2018-update.pdf

[26] Park, J., Pankratz, N., & Behrer, A. (2021). Temperature, Workplace Safety, and Labor Market Inequality. *IZA Discussion Paper* No. 14560

[27] Cui, W., Cao, G., Park, J. H., Ouyang, Q., & Zhu, Y. (2013). Influence of indoor air temperature on human thermal comfort, motivation and performance. *Building and environment*, *68*, 114-122.

[28] Clark, S. S., Chester, M. V., Seager, T. P., & Eisenberg, D. A. (2019). The vulnerability of interdependent urban infrastructure systems to climate change: Could Phoenix experience a Katrina of extreme heat?. *Sustainable and Resilient Infrastructure*, *4*(1), 21-35.

We focus on interventions that can be taken by households, local governments, and other entities to address these impacts and existing regulations that can address these impacts.

Interventions to address heat

There are many types of interventions that can be used to address adverse health and household-financial impacts associated with extreme heat. They generally fall into two categories: emergency management strategies that deal with extreme heat events, and non-emergency management strategies that address heat in a more long-term way.

The first set of policies include strategies such as heat alerts, and the operation of cooling centers that are used to minimize acute impacts of extreme heat.

The second set of strategies treat heat as a chronic stressor that exacerbates health and other risks. Examples of such long-term, non-emergency management, heat-adaptation strategies include urban greening, cool roofs, and design strategies that can reduce heat exposure and/or absorption by individuals and the built environment. These long-term strategies also include efforts to improve the thermal performance of buildings through weatherization; the installation of air conditioning; and the installation of solar PV — all of which can elevate individuals' ability to cope with the acute and chronic adverse impacts of extreme heat.

Table 1. summarizes these interventions. Appendix B provides a more detailed description of each intervention. Ultimately, the type and mix of interventions chosen should depend on the region, its specific climate conditions, existing built environment, and the needs of its constituents.[29]

Using a place-based or exposure setting framework

We use the lens of specific settings for our analysis, as settings are often discrete places that can be influenced by regulation that is enforced or monitored by affiliated state agencies. Because of this, we believe designing and implementing heat interventions in the context of specific settings (where feasible) can allow for efficient delivery as well as oversight of these protective policies. Settings are also often associated with particular populations — for instance, youth in schools and older adults in assisted living facilities. Influencing these places with regulations such as minimum heat thresholds or building code requirements can be a way to relay protective benefits to populations that are known to be particularly high risk for heat impacts, including youth and older adults, as well as environmentally exposed workers, low-income households, and incarcerated individuals.

We selected a limited number of critical settings to focus on for this analysis. This was based on our understanding of the settings in which individuals tend to spend significant periods of time, using analyses of the American Time Use Survey (ATUS); our understanding of which populations are particularly vulnerable to extreme heat; and discrete settings affiliated with these groups.

Based on an analysis of data from the American Time Use Survey (2003–2018), the settings in which individuals (ages 15 and older) tend to spend the most time on average include the home, the workplace, and transit, followed by other settings such as commercial spaces (e.g., restaurant, grocery store) and schools for younger respondents. (See **Appendix A** for more details). In terms of population groups that are particularly vulnerable to the impacts of extreme heat, we identified the following through a review of

[29] Burgess, K., & Foster, E. (2019). SCORCHED: extreme heat and real estate. *Urban Land Institute, Washington, DC*.

academic literature: older adults,[30] infants and youth,[31] outdoor workers, [32] those with preexisting health conditions,[33] low-income individuals,[34] incarcerated individuals,[35] and unhoused individuals among others.[36]

Based on this analysis of where individuals tend to spend time and experience potential heat exposure, a review of which population groups are particularly vulnerable to heat as well as settings that may be utilized by these groups, we identified the following settings of focus for this report: 1) Homes; 2) Workplaces; 3) Schools and Child Care Facilities; 4) Senior Assisted Living Facilities; 5) Prisons, Jails, and Correctional Facilities; 6) Public Outdoor Spaces (i.e., Parks, Recreation Spaces); 7) Public Transit Stops.

Approach to analysis by setting

For each setting, we answer the following questions to understand gaps at the setting level to improve heat risk-reduction policies and efforts across the state.

1) What are possible heat risk-reducing interventions for this exposure setting?
2) Which California state entity has oversight in regulating activities and/or selected interventions in this setting?
3) What heat-relevant laws or regulations exist for this setting?
4) What state funding opportunities exist for implementing heat risk-reducing interventions in these settings?

For the identification of interventions, we focused on interventions that could reduce adverse health or household-level financial impacts caused by heat. Examples were shown in Table 1 above.

For the identification of existing state laws or regulations around heat in a given setting, we reviewed relevant sections of the California Codes and the California Code of Regulations using the search engine Nexis Uni. We largely focused on identifying laws or regulations related to building code requirements to mitigate heat absorption or limit heat exposure; temperature threshold requirements for a setting (e.g., temperature must be maintained between X and X degrees); and operational protocols to maintain thermal safety for occupants or individuals in a setting (e.g., mandated rest in workplaces during high heat days).

For the identification of state funding opportunities, we identified funding that could be used by households, workplaces, schools, local jurisdictions, and/or nonprofits to support adaptation to extreme heat. Examples of programs that can help fund these interventions include low-income weatherization for households and grant programs that can be used by local jurisdictions or schools to address extreme heat (e.g., urban greening). We focused on

[30] Vandentorren, S., Bretin, P., Zeghnoun, A., Mandereau-Bruno, L., Croisier, A., Cochet, C., ... & Ledrans, M. (2006). August 2003 heat wave in France: risk factors for death of elderly people living at home. *The European Journal of Public Health*, *16*(6), 583-591.

[31] Xu, Z., Sheffield, P. E., Su, H., Wang, X., Bi, Y., & Tong, S. (2014). The impact of heat waves on children's health: a systematic review. *International journal of biometeorology*, *58*(2), 239-247.

[32] Moda, H. M., & Minhas, A. (2019). Impacts of climate change on outdoor workers and their safety: some research priorities. *International journal of environmental research and public health*, *16*(18), 3458.

[33] Zanobetti, A., O'Neill, M. S., Gronlund, C. J., & Schwartz, J. D. (2013). Susceptibility to mortality in weather extremes: effect modification by personal and small area characteristics in a multi-city case-only analysis. *Epidemiology (Cambridge, Mass.)*, *24*(6), 809.

[34] Centers for Disease Control and Prevention. (2017). *Heat and the Low Income.* https://www.cdc.gov/disasters/extremeheat/lowincome.html

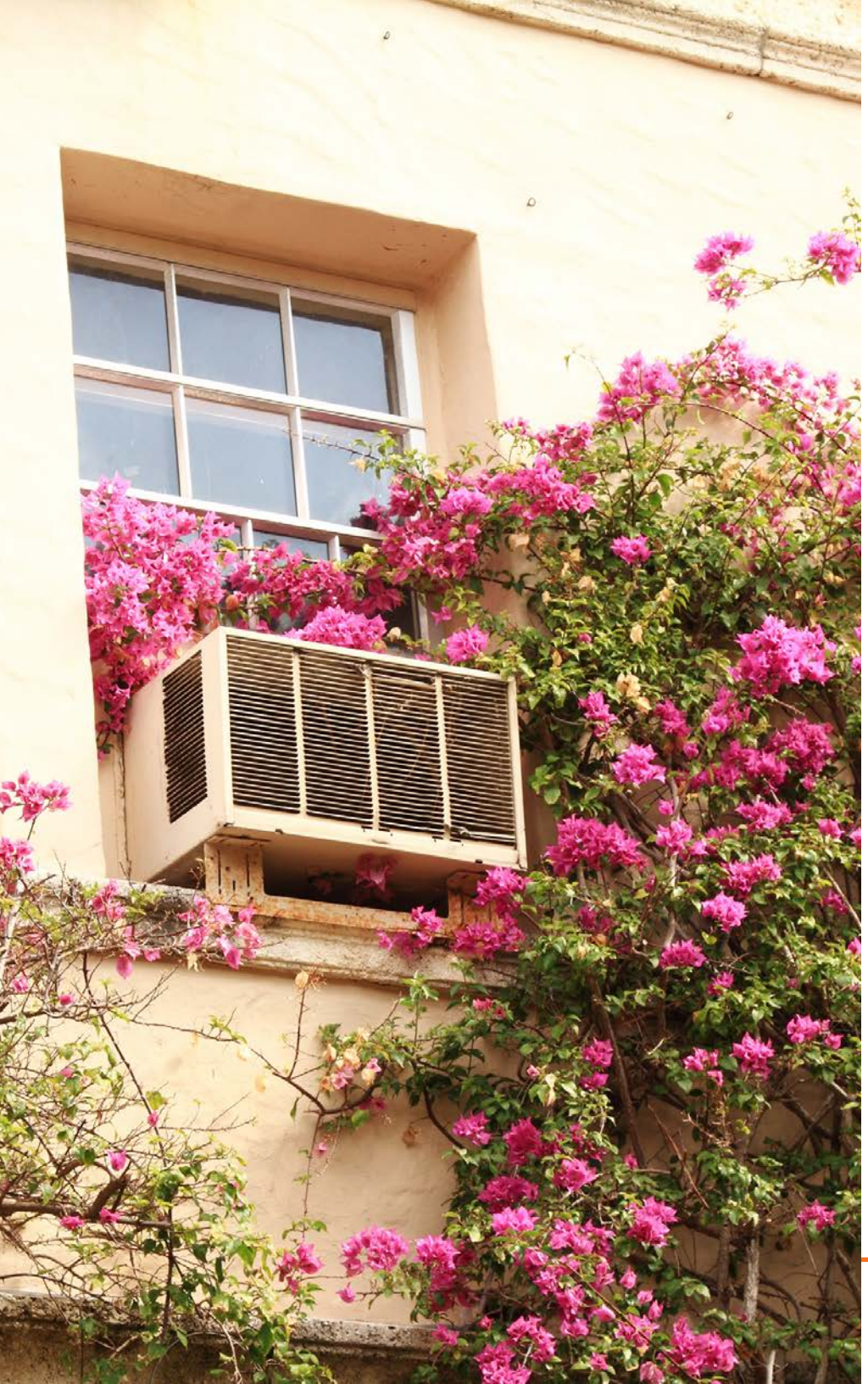
[35] Ramin, B., & Svoboda, T. (2009). Health of the homeless and climate change. *Journal of Urban Health*, *86*(4), 654-664.

[36] Skarha, J., Peterson, M., Rich, J. D., & Dosa, D. (2020). An Overlooked Crisis: Extreme Temperature Exposures in Incarceration Settings.

programs administered by agencies and specifically those that offered funding or were anticipated to offer funding in 2021 as of March 2021. We did not include loan programs, programs focused on wildfire-risk reduction, or energy efficiency programs administered by investor-owned utilities (IOUs).

We identified program information based on the most up-to-date version of program guidelines available online through the first quarter of 2021. Because there may have been and continue to be additional funding opportunities introduced throughout 2021, the list of programs included in this report may not be fully inclusive of existing opportunities after publication. And because program guidelines may change year to year, the information captured in this analysis is subject to change.

For each program, we identified the following information: 1) heat-relevant measures or offerings provided by the program; 2) heat considerations in program objectives; and 3) heat considerations in program eligibility criteria or funding allocation goals. We organized programs by the applicants or users of the programs, namely: households, workplaces, schools, and local governments.



Chapter 3: Homes

ACCORDING TO RESULTS from the American Time Use Survey, U.S. residents spend far more time in their home than they do in any other place or setting and the risk of heat exposure in the home is particularly concerning for certain vulnerable groups who disproportionately spend even more time in this setting. These include infants, children, seniors, and individuals with limited mobility.

Low-income Californians may also face distinctive risks of heat exposure at home for several reasons. First, they often reside in homes that are older or of poorer quality and have lower thermal performance. Second, they often reside in rental homes over which they may have less control over investments affecting their homes' thermal performance and the availability of cooling technologies. Third, because they have lower incomes, they may be forced to choose between spending on energy to cool their homes and other needs.

Who has the authority to make decisions about investments in the thermal performance or availability of cooling technologies within a home typically depends upon whether that home is owner-occupied or a rental unit. When designing policies to encourage, incentivize or mandate the adoptions of intervention heat risk-reducing interventions, it is critical to recognize the differing domains of control and incentives facing rental property owners, renters, and property owners.

Close to 60% of housing units in California were built in 1979 or

earlier.[1] These homes, which are roughly 40 years or older, were likely built with design and technology elements that are obsolete with respect to thermal performance. Most homes were designed, built, and appointed before engineers, architects, and building code planners anticipated increasing hotter temperatures in the future. Therefore, both owner-occupied and rental properties are likely to benefit from a variety of upgrades and retrofits.

For rental units, the issue of "split incentives" may pose challenges for making timely investments toward cooling technologies and retrofits. This problem arises when renters bear the operational energy costs of cooling their home but cannot invest in capital costs associated with upgrades and retrofits such as cool roofs, insulation, and air conditioning. Owners of rental properties are responsible for investing in these capital improvements but may do so sub-optimally because they do not consider operational energy costs that they could save. The split-incentives problem may cause rental properties to be retrofitted for thermal performance more slowly than owner-occupied homes and also cause renters to face higher operational costs compared to owner-occupants.

Interventions to address heat in the home

There are various interventions to mitigate heat or reduce heat-related risks in the home. Weatherization measures such as insulation, double-paned windows, window shading, and air sealing can increase the thermal performance of homes, making them more efficient in keeping heat out. Cool roofs can reduce heat absorption by the building by reflecting sunlight; rooftop solar PV panels similarly absorb less heat than standard roofing materials while also providing added benefits of generating renewable energy.

Air conditioning units are effective in quickly cooling interior spaces, although a significant downside is the effect of increased energy use, which elevates risks of utility blackouts while also contributing to greenhouse gas emissions. Outside of buildings, trees that are strategically planted to provide shade can reduce heat absorbed by buildings while also reducing ambient temperatures through evapotranspiration.

In terms of financial interventions for households**,** utility bill pay assistance can help these residents in shouldering increased costs from higher air conditioning use during high heat days.

Responsible state agencies

A wide range of state agencies oversee or influence the implementation of heat risk-reduction interventions relevant for homes through either the maintenance of building codes or through the administration of relevant programs and funding opportunities.

- For building codes, the California Building Standards Code, Title 24 of the California Code of Regulations (CCR) which includes the CalGreenCode, is maintained by the California Building Standards Commission. California's Building Energy Efficiency Standards is maintained by the California Energy Commission (CEC).
- For weatherization efforts, two state agencies offer programs that provide free or subsidized services and installations to low-income households and communities. The California Department of Community Services & Development (CSD) offers the Low-Income Weatherization Program (LIWP); the Low Income Home Energy Assistance Program (LIHEAP); and the Weatherization Assistance Program (WAP). The California Public Utilities Commission (CPUC) also oversees a low-income weatherization program,

[1] U.S. Census Bureau (2020). *Selected housing characteristics, 2015-2019 American Community Survey 5-year estimates*. https://data.census.gov/cedsci/table?q=United%20States&t=Housing&g=0400000US06&tid=ACSDP5Y2019.DP04

the Energy Savings Assistance Program (ESA).

- For solar PV, the CPUC oversees several programs directed at low-income communities, including the Disadvantaged Communities - Single-family Solar Homes (DAC-SASH); and the Solar on Multifamily Affordable Housing (SOMAH) program. DAC-SASH offers no-cost solar installations for low-income households in single-family homes, while SOMAH offers subsidized solar PV for multifamily buildings.
- In terms of utility bill pay assistance, the CPUC oversees several programs administered by investor-owned utilities, including the California Alternate Rates for Energy (CARE) and Family Electric Rate Assistance Program (FERA), which allows for reduced utility bill rates for low-income households; and the Medical Baseline Program, which provides reduced rates for those with selected medical conditions or who require using particular medical devices (e.g., respirators, motorized wheelchairs).

At the local level, there also may be unique programs and funding opportunities for weatherization measures, solar PV, and utility bill pay assistance. This may come through publicly owned utilities and local and rural cooperatives (which are not overseen by the CPUC).

State laws and regulations

There are currently no state regulations requiring indoor temperatures to be kept to a sufficiently cool level for general residential spaces. This is in contrast to requirements to ensure that building interiors can be made sufficiently warm for occupants. Specifically, state building codes require that …"interior spaces intended for human occupancy shall be provided with active or passive space heating systems capable of maintaining an indoor temperature of not less than 68°F (20°C)…."[2] While the building code mentions requirements around heating technologies, there are no similar requirements for cooling technologies in residential spaces.

In terms of the ability to pay for utility bills, there are legal requirements that prohibit utilities from terminating services for those with life-threatening conditions due to nonpayment.[3] Various utilities also have rules to prohibit utility shut-offs when temperatures are above a certain threshold; for instance Pacific Gas and Electric Company (PG&E) prohibits residential electricity disconnections "when temperatures above 100 degrees or below 32 degrees are forecasted by PG&E based on a 72-hour lookahead period…."[4] Southern California Edison (SCE) has similar rules.[5]

State funding opportunities

We identified 10 state programs and/or funding opportunities in existence between 2020 and the the first quarter of 2021 that could address heat exposure in the household setting. See **Table 2**.

Various heat-relevant interventions are supported by these programs, including home weatherization; the installation of cool roofs and/or solar PV; utility bill pay assistance; and air conditioner re-

[2] California Code of Regulations, Title 24, Part 2, Section 1203.1

[3] California Public Utilities Code, Section 779

[4] Pacific Gas & Electric Company (2020). *ELECTRIC RULE NO. 11. DISCONTINUANCE AND RESTORATION OF SERVICE.* https://www.pge.com/tariffs/assets/pdf/tariffbook/ELEC_RULES_11.pdf

[5] Southern California Edison (2020). *RULE 11. DISCONTINUANCE AND RESTORATION OF SERVICE* https://library.sce.com/content/dam/sce-doclib/public/regulatory/tariff/electric/rules/ELECTRIC_RULES_11.pdf

Table 2: State Funding Programs for Heat Risk-Reduction Interventions in Residential Settings

State Programs / Funding Resources	Utility Financial Assistance	AC Replacement / Repair	Weatherization	Urban Greening	Cool Roofs	Shade Structures	Solar PV	Plans to Address Extreme Heat
Low-Income Weatherization Program (LIWP)		X	X		X		X	
Low Income Home Energy Assistance Program (LIHEAP)	X	X	X					
Weatherization Assistance Program (WAP)			X					
Disadvantaged Communities - Single-family Solar Homes (DAC-SASH)							X	
Solar on Multifamily Affordable Housing (SOMAH) program							X	
Energy Savings Assistance Program (ESA)			X					
California Alternate Rates for Energy (CARE) / Family Electric Rate Assistance Program (FERA)	X							
Medical Baseline	X							
Affordable Housing and Sustainable Communities (AHSC) Grant Program				X	X	X	X	X
Transformative Climate Communities Program (TCC)		X	X	X	X	X	X	X

placement or repair. Among the three programs we identified that could be used to repair or replace existing air conditioning units, none could be used for the purchase or installation of *new, nonreplacement*, air conditioners. This may leave a gap for low-income households who could reap health benefits from an energy efficient air conditioner but cannot receive one because the household does not have a unit that can be replaced to begin with.

When reviewing these programs, we found that they had a variety of different objectives, ranging from reducing greenhouse gas emissions to financially assisting low-income households. None

had an explicit objective of mitigating heat or reducing adverse heat-related risks from households. (See Appendix C, Table C2). The LIWP program stood out in that it explicitly states the heat-related benefits that can be accomplished by the program, though it is not a primary objective of the program: "LIWP also helps cushion the impact of climate change on vulnerable communities, making it more affordable for low-income households to keep their homes cool and comfortable at a lower cost … and protect children and seniors from the health impacts of higher temperatures."[6]

When reviewing program guidelines, we found that most did not take the issue of heat into account for making decisions around funding eligibility and allocation to households or communities (such as through baseline temperature conditions, urban heat island effect, or projected temperatures). The exception was the WAP and LIHEAP programs administered by CSD, which uses a formula to allocate funds to service providers who deliver the program at the local level throughout the state. This formula takes into account the low-income population, utility and fuel costs, and climate conditions — namely heating and cooling degree days — to determine which regions should receive proportionally more program funds.[7,8,9]

Of the reviewed programs focused on the home setting, the AHSC program was also unique in that applicants are required to fill out a climate adaptation assessment matrix with climate projections for selected impacts, along with descriptions of adaptive measures that would be integrated into the project. Projected temperatures and extreme heat could be presented here, along with details on how the applicant intends to address this (e.g., integrating urban greening, using reflective materials in projects). Thus, considerations around climate resiliency are required to be integrated into the funding application, though the program is by no means explicitly focused on the issue of mitigating heat related risks, and ultimately, this component of the application makes up only three of 100 total possible points of the application scoring criteria. [10]

Of the household programs reviewed that have geographic eligibility criteria or priorities, the requirements are based on CalEnviroScreen DACs (e.g., AHSC, DAC-SASH, SOMAH) — not necessarily high-heat places. Additional details can be found in Tables C3 and C4 in Appendix C. Table C3 shows whether there are geographic eligibility criteria for programs that serve households and Table C4 shows whether there are geographic eligibility criteria and funding allocation targets for grant programs that serve households.

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[6] California Department of Community Services & Development (n.d.). *Low-Income Weatherization Program* https://www.csd.ca.gov/Pages/Low-Income-Weatherization-Program.aspx

[7] National Association for State Community Services Programs. (2020). *WAP Funding Allocation Formulas.* https://nascsp.org/wp-content/uploads/2020/05/WAP-Funding-Allocation-Formulas-Report.pdf

[8] State of California Department of Community Services and Development. (2019). *DRAFT 2019 State Plan and Application to the U.S. Department of Energy.* Accessed February 2021 from https: //www.csd.ca.gov/Shared%20Documents/2019-DOE-State-Plan.pdf

[9] State of California Department of Community Services and Development. (2020). *CALIFORNIA LOW INCOME HOME ENERGY ASSISTANCE PROGRAM STATE PLAN-* https://www.csd.ca.gov/Shared%20Documents/2020_LIHEAP_State_Plan.pdf

[10] California Strategic Growth Council. (2020). *Affordable Housing and Sustainable Communities Program Round 6 Draft FY 2019-2020 Program Guidelines* https://sgc.ca.gov/programs/ahsc/docs/20200916-AHSC_Round_6_Draft_Guidelines.pdf

Chapter 4: Workplaces

SECOND TO THE HOME, the workplace is the location in which U.S. residents tend to spend more time than in any other setting. Several factors influence heat exposure in the workplace. Outdoor workers are often more exposed to heat than indoor workers. These include workers in industries such as agriculture, construction, landscaping, mail and package delivery, oil and gas well operations, and warehousing, among others.[1] The nature and intensity of physical exertion required in selected work environments can also increase thermal burden on individuals, as can special clothing or equipment. A recent study by Park, Pankratz, & Behrer (2021) show that high temperatures not only lead to increases in heat illnesses but also lead to higher rates of injuries not typically categorized as heat illness (e.g., 'falling from ladder').[2] The authors find that current records of workplace injuries likely underestimate the net health and economic impacts of heat on workers.

[1] U.S. Department of Labor Occupational Safety and Health Administration. (n.d.). *Heat*. https://www.osha.gov/SLTC/heatstress/index.html

[2] Park, J., Pankratz, N., & Behrer, A. (2021). Temperature, Workplace Safety, and Labor Market Inequality.

Perhaps the single most distinguishing feature of the workplace as relates to heat is the extent of control that employers have over heat exposure faced by workers. In indoor workspaces, employers can control indoor climates and can make capital and operating expenditures to ensure spaces are kept sufficiently cool. In both indoor and outdoor workplaces, the employer generally oversees the location, exertion levels and rest times, and required clothing and special equipment used by workers.

Interventions to address heat in the workplace

Because of the degree of their control over both the workplace environment and working conditions, employers have a wide range of heat risk-reduction interventions available to them. Relevant interventions to mitigate heat or reduce heat-related risks in workplaces include behavioral interventions such as mandated rest time, water, shade, monitoring for heat illnesses, and training around heat illness emergency management protocols should medical intervention be needed for a worker.

In indoor work settings, interventions to address heat include air conditioning as well as alternative or supplementary temperature control measures (e.g., water misters, fans). Other interventions include built environment upgrades to improve thermal performance and/or to reduce heat absorption by the building (e.g., insulation, double-paned windows, window shading, air sealing, cool roofs, solar PV, shade trees outdoors). Building codes can influence the adoption of these measures.

Responsible state agencies

Several state agencies influence the heat exposure and/or the implementation of heat risk-reduction interventions in workplaces.

- In terms of building codes for nonresidential settings, the California Building Standards Code, Title 24 of the California Code of Regulations (CCR) which includes the CalGreenCode, is maintained by the California Building Standards Commission. California's Building Energy Efficiency Standards is maintained by the California Energy Commission (CEC).
- For behavioral interventions, the Division of Occupational Safety and Health within the California Department of Industrial Relations, known as Cal/OSHA, is the primary agency overseeing the enforcement of protective regulations in the workplace. It administers the Outdoor Heat Illness Prevention standard, which requires all outdoor places of employment to provide water and access to shade; to develop a heat illness-prevention plan; and to provide heat illness prevention and response trainings to employees, among other requirements. Cal/OSHA provides guidance to employers through trainings and consultations so that workplaces can effectively comply with the standard, and also conducts inspections and audits to ensure compliance. Cal/OSHA is also developing a heat illness-prevention standard for indoor places of employment.
- For energy-related goals focused on the adoption of more energy efficient cooling technology (and less heat-producing technologies), many individual investor-owned utilities have dedicated programs for commercial and industrial energy users, which are regulated by the CPUC.[3] These programs can create financial savings and for selected measures, can provide overlapping ther-

[3] California Public Utilities Commissions. (n.d.). *Energy Efficiency.* https://www.cpuc.ca.gov/energyefficiency/

mal comfort benefits for workers (e.g., weatherization, building envelope improvements).

State laws and regulations

Adopted in 2006, California's Outdoor Heat Illness Prevention standard requires all outdoor places of employment to provide water and access to shade; to develop a heat illness prevention plan; and provide heat illness prevention and response trainings to employees. Per the standard, employers must follow emergency response procedures such as taking immediate action to address signs and symptoms of possible heat illness (commensurate with severity). The standard also requires employers to closely observe workers during "heat wave" periods (defined as any day in which the predicted high temperature will be 80 degrees Fahrenheit or above, and at least 10 degrees higher than the average high daily temperature in the preceding five days); and to closely observe any workers who are newly assigned to a high-heat area for the first 14 days.[4]

In addition to these baseline requirements, additional high-heat procedures must be followed when temperatures reach or exceed 95 degrees Fahrenheit. These include ensuring effective communication so that employees can contact a supervisor when necessary; observing employees for alertness and signs or symptoms of heat illness; designating at least one employee on each worksite to call for emergency medical services and allowing other employees to make these calls if a designated person is not present; reminding employees to drink water; holding pre-shift meetings before work to review high-heat procedures and prevention activities, and to provide reminders on employees' rights to take cooldown rest when necessary. In addition, for the agriculture sector, employers must ensure that workers take a minimum 10-minute net preventative cooldown rest period every two hours when temperatures reach 95 degrees or above. [5]

The Indoor Heat Illness Prevention Standard is in development. The most recent draft version published in April 2019 would require all workplaces in which the indoor temperature exceeds 82 degrees while employees are present to provide access to water and cooldown areas; to maintain close observation of employees during high-heat periods or when new employees are acclimatizing to the work area; to provide heat illness-prevention training to staff; and to develop a heat illness prevention plan. It would also require additional heat illness-prevention measures when the temperature or heat index exceeds 87 degrees while employees are present, or if employees wear restricting clothing or work in high radiant heat areas and the temperature equals or exceeds 82 degrees.

Additional requirements for these conditions involve taking temperature measurements and keeping records, as well as using the following types of measures to minimize the risk of heat illness: engineering controls (e.g., air conditioning, fans, mist fans, ventilation); administrative controls (e.g., rotating employees, scheduling work earlier or later in the day, reducing work speeds); and through personal heat-protective equipment (e.g., water-cooled garments, cooling vests).[6]

Employers must use engineering controls to reduce temperatures and the heat index below 87 degrees and below 82 degrees in

[4] California Code of Regulations, Title 8, Section 3395

[5] California Code of Regulations, Title 8, Section 3395

[6] State of California Department of Industrial Relations (2019). *Heat Illness Prevention Draft Text*. https://www.dir.ca.gov/dosh/doshreg/Heat-Illness-Prevention-Indoors/Draft-revisions-Apr-22-2019.pdf

sites where employees wear restrictive clothing or are exposed to high radiant heat; if engineering controls are insufficient to reduce temperatures, administrative controls and/or personal heat-protective equipment are also required. The employer may use administrative controls in lieu of engineering controls if the employer demonstrates that the administrative controls can minimize the risk of heat illness more effectively than engineering controls.

State funding opportunities

We did not identify any state funding opportunities to address heat exposure in workplace settings. Cal/OSHA's Heat Illness Prevention Program offers informational resources and training to employers and workers to reduce heat-related risks and maintain compliance with the Outdoor Heat Illness Prevention Standard. However, we were not able to identify any state programs that offer financial assistance to workplaces to implement heat risk-reducing strategies. [7]

[7] There may be energy efficiency programs dedicated to commercial and industrial energy users (offered by investor-owned and other utilities) that are not included in this analysis.

Chapter 5: Schools and Child Care Facilities

CHILDREN ARE PARTICULARLY VULNERABLE to heat-induced health impacts. Physiologically, children's thermoregulatory systems are less developed than those of adults, making them more susceptible to dehydration and heat stress.[1] They also cannot make behavioral adjustments (e.g., accessing air-conditioned spaces, shade, water) as readily as adults. The impact of high temperatures on air quality is also particularly harmful to children, who have underdeveloped respiratory systems.[2] Youth who participate in exercise or sports outdoors during high-heat days face additional risks. Increased heat production from exertion, in combination with clothing or gear (e.g., helmets, insulated clothing) that limit effective cooldown makes athletes at risk of overheating. Without

[1] Xu, Z., Hu, W., Su, H., Turner, L. R., Ye, X., Wang, J., & Tong, S. (2014). Extreme temperatures and paediatric emergency department admissions. *J Epidemiol Community Health*, *68*(4), 304-311.

[2] Sheffield, P. E., Knowlton, K., Carr, J. L., & Kinney, P. L. (2011). Modeling of regional climate change effects on ground-level ozone and childhood asthma. *American journal of preventive medicine*, *41*(3), 251-257.

precaution, this can lead to illnesses that range from mild conditions such as heat rash and heat cramps to more severe illnesses such as heat exhaustion and heat stroke, which can be life-threatening if left untreated.[3]

Beyond health outcomes, recent studies have revealed linkages between heat exposure and educational outcomes among youth. Park (2017) shows that students' exposure to hot days (above 80F) reduced exam performance among high school students in New York City public schools, which had lasting impacts beyond the exam by affecting high school graduation outcomes.[4]

Interventions to address heat in schools and child care facilities

In schools and child care centers, the primary actor for implementing building upgrades, temperature control technologies, or behavioral interventions to reduce heat risks is the school or child care center itself. Interventions to address heat include built environment upgrades such as building envelope improvements (e.g., insulation, double-paned windows, window shading, air sealing) that improve thermal performance and maintain cooler indoor temperatures. They also include cool roofs, solar PV, and shade trees outdoors. Building codes can influence the adoption of these measures. Air conditioning use can maintain sufficiently cool climates.

Behavioral interventions can also be helpful for reducing health risks for youth in schools and child care centers. Examples include canceling or rescheduling outdoor activities (e.g., sports practices, games, outdoor play) during high-heat periods; moving children to air-conditioned rooms or cooler parts of buildings; providing staff with training to recognize signs of heat illness and recommended responses; providing trainings to parents and children regarding heat-related risks; and encouraging children to take preventative behaviors such as drinking water to stay hydrated.

Responsible state agencies

Several state agencies influence the implementation of heat risk-reduction interventions in schools and child care centers.

- For school buildings, each school district must follow the state's Building Standards Code (Title 24 of CCR), maintained by the California Building Standards Commission. If schools receive state funding for developing new school sites, new construction, or modernizing existing facilities, they must have their building plans reviewed and approved by the Department of Education pursuant to the Education Code (Title 5).[5]
- For child care facility buildings, buildings must also follow the state's Building Standards Code (Title 24 of CCR), maintained by the California Building Standards Commission. The State's Community Care Licensing Division within the Department of Social Services regulates the licensing and inspections of child care facilities throughout the state. It conducts periodic compliance checks for code requirements related to facility buildings, grounds, and operations to ensure the health and safety of children.[6] Indoor temperature maintenance is one of several code requirements.[7]

[3] Howe, A. S., & Boden, B. P. (2007). Heat-related illness in athletes. *The American Journal of Sports Medicine*, *35*(8), 1384-1395.
[4] Park, R. J. (2020). Hot temperature and high stakes performance. *Journal of Human Resources*.
[5] California Code of Regulations, Title 5, Sections 14032, 14033
[6] California Health and Safety Code, Division 2, Chapter 3.5, Article 3
[7] California Code of Regulations, Title 22, Division 12, Chapter 1

State laws and regulations

In terms of school buildings, there are no requirements around indoor temperatures or requirements around heat mitigation in broader school campuses (e.g., school yards) as part of Title 5. Air conditioning is not a statewide requirement in school buildings.[8]

In terms of behavioral responses to address heat, we were not able to find any legal requirements for schools to establish heat illness prevention or response guidelines (e.g., modifying athletic activities; relocating classes to spaces that are air-conditioned). While some school districts have hot weather guidelines that outline protocols for modifying outdoor activities at different heat index thresholds,[9] there is no statewide standard or requirement for heat levels at which youth athletic activities are advised to be modified or canceled. The decision and approach to establishing heat response protocols fall under the purview of individual schools and school districts.

In terms of heat illness prevention in sports, as of January 2019, participants in the California High School Coaching Education and Training Program must be certified in a CPR or First Aid program that includes heat illness as a review component. Coaches hired by high schools in California must go through this training program to achieve a basic understanding of the signs and symptoms of heat illness, as well as appropriate responses to heat illness.[10]

In terms of heat exposure regulations in child care facilities, these facilities must be licensed by the state's Community Care Licensing Division and must follow operational regulations, including temperature maintenance. Specifically, facilities must "maintain the temperature in rooms that children occupy between a minimum of 68 degrees F (20 degrees C) and a maximum of 85 degrees F (30 degrees C). In areas of extreme heat the maximum shall be 20 degrees F (11.1 degrees C) less than the outside temperature."[11] While regular facility inspections are required by the Community Care Licensing Division, temperature readings from facilities are not consistently recorded in inspection reports. [12]

State funding opportunities

We identified three state programs that can be used to address the issue of heat in schools. We were not able to identify any such programs for child care centers as shown in **Table 3.**

As shown in Table 3, the three identified programs support interventions such as air conditioner replacement; weatherization; and urban greening. When reviewing the objectives of these programs, we found they had a variety, ranging from greenhouse gas emissions reductions to financially assisting low-income households. None of the programs had an explicit objective of mitigating heat or reducing adverse heat-related risks from households. For a program such as Urban Greening, urban heat island mitigation and energy conservation efforts could be funded by the program and was identified as co-benefits that can be supported by project activities; however, it was not described as primary program objective.

[8] California Code of Regulations, Title 5, Section 14030

[9] Hacienda La Puente Unified School District. (2012). *Heat Advisory Precautions for Schools.* http://lahs-hlpusd-ca.schoolloop.com/file/1379140872923/4203763690153 4988.pdf

[10] California Education Code, Section 35179.1

[11] California Code of Regulations, Title 22, Section 101239

[12] California Department of Social Services Community Care Licensing Division. (n.d.). *Search by Facility Group.* https://www.ccld.dss.ca.gov/carefacilitysearch/

Table 3: Programs to fund heat risk-reducing intervention in schools

State Programs / Funding Resources	Utility Financial Assistance	AC Replacement / Repair	Weatherization	Urban Greening	Cool Roofs	Shade Structures	Solar PV	Planning to Address Extreme Heat
School Facility Program Modernization Grants		X	X					
Urban Greening (UG)				X				
Environmental, Enhancement & Mitigation Program (EEM)				X				

Heat considerations for program eligibility or funding allocation

When reviewing program eligibility and/or funding allocation criteria, we found that none took heat considerations into account. The EEM and School Facility Program Modernization Grants were offered statewide. For UG, the only geographic eligibility criterion was that projects must be in urban areas. None of the three programs used climate conditions (e.g., current or projected number of extreme heat days, average temperatures) as a basis for considering funding allocation or prioritization. Additional details can be found in Table C4 in Appendix C.

Chapter 6: Senior Living Facilities

THE SENIOR POPULATION in California is growing. The population 65 or older is projected to reach approximately 8.7 million by 2030 and approximately 10.3 million by 2040, compared to 6.2 million in 2020.[1] Older adults are particularly vulnerable to heat-related health impacts. Physiologically, the ability to sense heat and to efficiently thermoregulate becomes compromised with age[2] and older adults are more likely to have preexisting conditions (e.g., cardiovascular, pulmonary) which can make them more susceptible to heat-induced illnesses or mortality. It is also more likely for older adults than younger persons to be using medications that impair thermoregulation. Limited mobility can also affect older adults' ability to respond to heat events.

Of the growing older adult population, it is estimated that more than 1 million seniors will require some assistance with self-care by 2030.[3] It is estimated that most older adults will prefer to "age in place" in their own homes for as long as possible, relying on supportive services before opting for out-of-home care.[4] For those who prefer to age in place, Chapter 3 on the home is most relevant.

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1 State of California Department of Finance. (2021). *P-1B Total Population by Individual Year of Age*. [Dataset]. https://www.dof.ca.gov/forecasting/demographics/projections/

2 Van Someren, E. J. (2007). Thermoregulation and aging. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, *292*(1), R99-R102.

3 Beck, L., & Johnson, H. (2015). Planning for California's growing senior population. *Public Policy Institute of California*.

4 Ibid.

This chapter focuses on assessing policy gaps for the many types of living facilities for older adults in California. Living facilities for older adults in California include (but are not limited to):

- **Private Homes** represent standard housing units occupied by older adults that do not include personal care or medical support by the housing provider.
- **Residential Care Facilities for the Elderly (RCFE)** are a "housing arrangement for persons, 60 years of age and over, where 24-hour non-medical care and supervision is provided. Residential Care Facility for the Elderly are often referred to as assisted living facilities, or board and care homes."[5]
- **Continuing Care Retirement Communities (CCRC)** "offer a long-term continuing care contract that provides for housing, residential services, and nursing care, usually in one location, and usually for a resident's lifetime." [6]
- **Skilled Nursing Facilities** are medical facilities that are "allowed to provide services that cannot be dispensed in assisted living or board and care homes. Typically these services involve managing complex and potentially serious medical problems.... They offer both short and long term care options."[7]

Interventions to Address Heat in Senior Living Facilities. The capital investments and building upgrades needed to manage and reduce heat risk in senior living space are similar to those discussed earlier for homes and workplaces. These include building envelope improvements (e.g., insulation, double-paned windows, window shading, air sealing) that enhance thermal performance and maintain cooler indoor temperatures. They also include cool roofs, solar PV, and shade trees outdoors. Building codes can influence the adoption of these measures. Air conditioning use can maintain sufficiently cool climates.

Behavioral interventions can also be helpful for reducing health risks for older adults. These include encouraging older adults to stay indoors and stay hydrated during high temperature periods; providing caretakers or staff from facilities who can recognize signs of heat illness and take response measures; and requiring more frequent monitoring of older adults during periods of high heat.

Responsible state agencies

Several state agencies oversee programs, resources, and regulations relevant to the well-being of older adults. Below are selected agencies that can influence the implementation of heat risk reduction interventions in various settings occupied by older adults.

- The state's Community Care Licensing Division within the Department of Social Services oversees the licensing and regulation of RCFEs and CCRCs. The agency additionally regulates the following types of facilities: Adult Residential Facilities for Persons with Special Health Care Needs (ARFPSHN), Adult Residential Facilities (ARF), Residential Care Facilities for the Chronically Ill (RCFCI), Adult Day Programs (ADP). Enhanced Behavioral Support Homes-ARF (EBSH), Community Crisis Homes-ARF (CCH), and Social Rehabilitation Facilities (SRF).
- The **California Department of Public Health** regulates medical facilities and serves as the state's survey agency (SA) contracted by the federal Centers for Medicare and Medicaid Services (CMS) to enforce national standards for nursing homes that participate

[5] California Department of Social Services. (n.d.). *Adult and Senior Care Program.* https://www.cdss.ca.gov/inforesources/community-care/ascp-centralized-application-units

[6] Ibid.

[7] California Registry (n.d.). *Nursing Homes in California.* https://www.calregistry.com/nursing-homes-in-california/

in the Medicare and Medicaid (Medi-Cal in California) programs, including Skilled Nursing Facilities.[8] CDPH also licenses Adult Day Health Care (ADHC) centers.[9] Specifically, the Field Operations Branch within the Licensing and Certification Program of CDPH's Center for Health Care Quality (CHCQ), has regulatory oversight of SNFs, hospitals, and other health care facilities. The branch includes around 600 Health Facility Evaluation Nurses (HFENs) who regularly survey facilities and investigate complaints to ensure compliance with state laws and regulations, as well as federal statutes if the facilities receive Medicare or Medi-Cal reimbursement.[10] CHCQ recently transitioned from annual state inspection surveys to increased on-site visits by HFENs throughout the year, which is expected to provide more frequent assessment and regulatory enforcement, and more systematically recurrent feedback on noncompliance issues to SNF providers.[11]

- **California Department of Aging (CDA)** Under the umbrella of the California Health and Human Services Agency (CHHS), the CDA administers programs that serve older adults, adults with disabilities, family caregivers, and residents in long-term care facilities throughout the state. [12] CDA contracts with the network of 33 Area Agencies on Aging (AAA), which manage a wide array of services for older adults, including support for independent living, support for caregivers, meal prep, and others. CDA also contracts with 38 agencies that operate the Multipurpose Senior Services Program (MSSP), which provides a variety of services and resources for older adults living at home. In addition, CDA, in partnership with CDPH and the Department of Health Care Services (DHCS), jointly administers the Community-Based Adult Services program, which is a day health program that provides services including nursing services, social services, and personal care, with the objective of restoring or maintaining capacity for self-care among older adults. CDA certifies the approximately 242 Adult Day Health Care Centers that are part of the CBAS program.[13]
- The **California Department of Social Services (CDSS)** administers the In-Home Supportive Services (IHSS) Program, which helps pay for services provided to adults over age 65; the services that can be offered through IHSS include housecleaning, meal preparation, laundry, and personal care, among others.[14] Two branches of the Community Care Licensing Division within the Department of Social Services participate in the regulation of CCRCs, the Adult and Senior Care Program and the Continuing Care Branch. Since regulations for temperature requirements and heat interventions fall under facility operation, the Adult and Senior Care program monitors CCRCs for compliance with the Community Care licensing laws and regulations regarding buildings and grounds. While annual inspections were halted for the first

[8] California Advocates for Nursing Home Reform. (n.d.). *Will New Inspection System Bring Same Old Results?* http://www.canhr.org/newsroom/newdev_archive/2017/will-new-inspection-system-bring-same-results.htm

[9] California Department of Aging. (2021). *Community-Based Adult Services (CBAS)*. https://aging.ca.gov/Providers_and_Partners/Community-Based_Adult_Services/Program_Narrative_and_Fact_Sheets/

[10] California Department of Public Health. (2020). *Center For Health Care Quality.* https://www.cdph.ca.gov/Programs/CHCQ/Pages/CHCQHome.aspx

[11] California Department of Public Health. (2020). *Skilled Nursing Facilities: COVID-19.* https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/SNFsCOVID_19.aspx

[12] California Department of Aging (n.d.) *Programs & Services.* https://www.aging.ca.gov/Programs_and_Services/

[13] California Department of Aging. (2021). *Community-Based Adult Services (CBAS)*. https://aging.ca.gov/Providers_and_Partners/Community-Based_Adult_Services/Program_Narrative_and_Fact_Sheets/

[14] California Department of Social Services (n.d.). *In-Home Supportive Services (IHSS) Program.* https://www.cdss.ca.gov/in-home-supportive-services

year of the pandemic, annual inspections of RCFEs are reinstated as of May 10, 2021 and as such Licensing Program Analysts (LPAs) will verify licensee compliance with statutes, regulations and other written requirements that are most relevant to protecting the health of persons in care and staff, including infection control practices. If noncompliance is found, LPAs determine the classification of a citation to be issued depending on the deficiency in compliance and the length of time permitted for a correction to be made. Noncompliance can result in a civil penalty.

- The **California Building Standards Commission** maintains the state's Building Standards Code (Title 24 of CCR), including the CalGreenCode.

State laws and regulations

Below are state regulations around temperature requirements in selected senior living facilities.

- **Private Home:** Standard building code requirements for residential spaces occupied by older adults.
- **Residential Care Facilities for the Elderly (RCFE):** California law mandates that RCFE settings (or "assisted living facilities" or "board and care homes") maintain temperature controls and allow residents to adjust temperatures as desired.[15] Specifically, facilities must heat occupied rooms to a minimum of 68 degrees F and cool rooms to a comfortable range, defined as 78 degrees F to 85 degrees F. In areas of extreme heat, rooms must be cooled to 30 degrees F less than the outside temperature.
- **Continuing Care Retirement Communities (CCRC):** Since CCRCs require RCFE licenses,[16] CCRC facilities must maintain temperature controls mandated by "Residential Care Facilities For The Elderly Manual of Policies and Procedures,"[17] including heating occupied rooms to a minimum of 68 degrees F; and cooling rooms to a comfortable range, defined as between 78 degrees F and 85 degrees F. In areas of extreme heat, rooms must be cooled to 30 degrees F less than the outside temperature, and residents shall face no statutory prohibition from adjusting individual thermostatic controls.[18]
- **Skilled Nursing Facilities:** For nursing facilities, per 42 CFR § 483.10 (Code of Federal Regulations), skilled nursing facilities must be at a comfortable or safe temperature. For facilities established after 1990, this must be between 71 F and 81 F. While all states' nursing facilities must comply with 42 CFR § 483.10 and states can decide to institute more specific or stringent temperature requirements for nursing facilities, California does not have any in place and instead refers to federal regulations.

State Funding Opportunities

To our knowledge, there are no state agency programs exclusively dedicated to senior heat risk reduction. However, there are programs offered by California's Department of Aging, Department of Social Services, and Department of Health Care Services that may be useful avenues through which to deliver heat risk-reducing efforts for seniors (e.g., temperature monitoring, risk warnings during high heat days, air conditioning installations and/or rebates).

[15] California Department of Social Services. (2008). *Residential Care Facilities For The Elderly Manual of Policies and Procedures.* https://www.cdss.ca.gov/ord/entres/getinfo/pdf/rcfeman2.pdf#page=29

[16] California Department of Social Services. (n.d.). *Continuing Care Contracts.* https://www.cdss.ca.gov/inforesources/community-care/continuing-care

[17] California Department of Social Services. (n.d.). *Laws and Regulations.* https://www.cdss.ca.gov/inforesources/community-care/continuing-care/laws-and-regulations

[18] California Department of Social Services. (2008). *Residential Care Facilities For The Elderly Manual of Policies and Procedures.* https://www.cdss.ca.gov/ord/entres/getinfo/pdf/rcfeman2.pdf#page=29

Chapter 7: Prisons, Jails, and Correctional Facilities

INCARCERATED INDIVIDUALS ARE SOME of the most vulnerable populations to adverse heat-related health outcomes. These individuals have very limited agency over most facets of day-to-day life, including the ability to control indoor temperatures and limit exposure to heat by moving to cooler indoor or outdoor locations. Particularly vulnerable individuals include older inmates, those with disabilities or preexisting health conditions, and those in certain types of confinement for instance, those with very limited time outdoors.

In California, it is estimated that there were 160,000 incarcerated individuals at the end of 2020. The conditions in many facilities have long been known to be overcrowded and unsafe, which can increase heat-related health risks. In late 2019, it was found that California prisons were operating at 135% of design capacity—understood as the number of people a facility can hold as determined by the architect or planner—and at 97% of operational capacity, or the number of people a facility can hold based on staffing and services. In December 2020, these numbers were

lower, but still high at 100% and 78% respectively. [1]

There have been long-term efforts to reduce overcrowding in California's prisons, most decisively put in motion following a 2011 Supreme Court decision that led to more incarcerated individuals being sent to county jails over the last decade. [2] However, because most county jails were not designed to house individuals for extended sentences, this may have caused less safe conditions for incarcerated individuals in many local jails. [3]

Interventions to address heat in prisons, jails, and correctional facilities

A study focused on the issue of heat exposure in U.S. prisons and jails identifies several recommendations for adapting to threats posed by extreme heat. Such include: reducing the size of the incarcerated population; reducing inmates' and correctional officers' susceptibility to heat stress through acclimatization practices and by prioritizing particularly heat-vulnerable populations for housing in units where safe temperature ranges can be maintained; phasing out obsolete or problematic facilities that cannot be cost-effectively retrofitted; retrofitting facilities that can be adapted; and requiring that safe temperatures be maintained in private facilities, among other recommendations.[4]

Responsible state agencies

Several state agencies influence the implementation of heat risk-reduction interventions in prisons, jails, and correctional facilities.

- The state agency with oversight over implementing heat-related interventions in state detention facilities is the California Department of Corrections and Rehabilitation (CDCR), which operates all state adult prisons and juvenile facilities in addition to overseeing various community correctional facilities.[5] Over 70 state facilities are operated by the CDCR, including prisons, conservation camps, and community correctional facilities for adults, as well as correctional facilities and conservation camps for youth.[6]
- The Board of State and Community Corrections (BSCC) is the agency that "promulgates regulations for adult and juvenile detention facilities, [and] conducts regular inspections of those facilities..." [7] The BSCC also inspects facilities "....for compliance of standards and directs funding for construction of local adult and juvenile detention facilities.... It is also the administering agency for a host of federal and state public safety grants."[8] The BSCC must adopt and prescribe minimum standards for local correctional facilities,[9] juvenile halls,[10] and juvenile ranches, camps, or

[1] Widro, E. (2020*). Since you asked: Just how overcrowded were prisons before the pandemic, and at this time of social distancing, how overcrowded are they now?* https://www.prisonpolicy.org/blog/2020/12/21/overcrowding/#capacity_appendix

[2] Horne, C., & Newman, W. J. (2015). Updates since Brown v. Plata: alternative solutions for prison overcrowding in California. *The journal of the American Academy of Psychiatry and the Law*, *43*(1), 87-92.

[3] Pohl, J. (2019). *California Tried to Fix Its Prisons. Now County Jails Are More Deadly.* https://www.propublica.org/article/california-fresno-county-jail-deaths.

[4] Holt, D. (2015). Heat in us prisons and jails: Corrections and the challenge of climate change. *Available at SSRN 2667260*.

[5] California Penal Code, Part 3, Title 7, Sections 5000 - 5031

[6] California Department of Corrections and Rehabilitation (CDCR). (n.d.). *Facility Locator.* https://www.cdcr.ca.gov/facility-locator

[7] Board of State and Community Corrections. (2021). *About the Board of State and Community Correction*s. https://www.bscc.ca.gov/m_bsccboard/

[8] Board of State and Community Corrections. (2021). *About the Board of State and Community Correction*s. https://www.bscc.ca.gov/m_bsccboard/

[9] California Penal Code, Part 3, Article 1, Section 6030

[10] California Welfare and Institutions Code, Division 2, Part 1, Chapter 2, Sections 200 - 224.6.

forestry camps.[11] In total, BSCC has oversees over 500 local detention facilities with differing regulations based on facility type. County jails, city jails, police departments, and police stations are included within these facility types.[12]

- The California Building Standards Commission maintains the state's Building Standards Code (Title 24 of CCR), including building code requirements relevant to prisons, jails, correctional centers, detention centers, juvenile halls, and other settings that are inhabited by individuals under restraint or security. [13]

State laws and regulations

We did not identify any state requirements in building codes mandating temperature controls in California state prisons, jails, or correctional facilities.[14] We also did not identify any operational requirements to maintain temperatures as a dedicated threshold in facilities. [15]

In the CDCR's "Sustainability Roadmap 2020-2021" report, the agency recognizes the threat extreme heat will pose on facilities and occupants. It identifies the facilities that will be most affected by heat exposure and notes that "[a]pproximately half of the CDCR adult correctional facilities are in areas of the State that have moderate to high summer temperatures." [16] It also notes that the majority of inmate housing has traditionally relied on evaporative cooling which "...can provide little relief in extreme heat events" and that "only a small portion of each facility typically has refrigerated cooling." [17] While recognizing the impacts extreme heat will have on facilities, the report notes that "...due to historic funding shortages, CDCR's backlog of deferred maintenance has continued to increase, delaying the replacement or repair that could bring needed upgrades and efficiencies." [18]

State funding opportunities

We could not identify any state funding opportunities to address the issue of heat specifically in prisons, jails, or correctional facilities.[19]

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[11] California Welfare and Institutions Code, Division 2, Part 1, Chapter 2, Article 24, Section 885

[12] Board of State and Community Corrections (BSCC). (2021). *Open Facilities as of 3.10.21.* https://www.bscc.ca.gov/wp-content/uploads/All-facilities-list-for-web-3.10.21.pdf

[13] California Code of Regulations, Title 24, Section 408 & Sections 1230 - 1231

[14] California Code of Regulations, Title 24, Part 2 Section 408 identifies building standards specific to prisons, jails, correctional centers, detention centers, juvenile halls, and other settings that are inhabited by individuals under restraint or security. Title 24, Part 2, Section 1230 - 1231 provides additional details on minimum standards for juvenile facilities and local detention centers.

[15] California Code of Regulations, Title 15, Division 3, Chapter 1

[16] California Department of Corrections and Rehabilitation. (2021). *Sustainability Roadmap 2020-2021.* https://www.cdcr.ca.gov/green/wp-content/uploads/sites/176/2020/04/R_2020-21-CDCR-Sustainability-Roadmap-FINAL-Electronic-Signature.pdf

[17] Ibid.

[18] Ibid.

[19] California Board of State and Community Corrections. (n.d.). https://www.bscc.ca.gov/s_cppgrantfundedprograms/

Chapter 8: Outdoor Public Spaces: Urban Parks and Recreation Spaces

OUTDOOR PUBLIC SPACES such as urban parks and recreation spaces improve our physical and psychological health and strengthen the social and cultural fabric of our communities. Parks and greenspace can provide cooling benefits outside of their immediate parameters through evapotranspiration by trees and other vegetation, thereby reducing the so-called urban heat island effect. They may also serve as a cooling refuge during periods of high heat if well-shaded with vegetation or built structures.

While the availability of shaded parks and greenspace may serve as a resource for communities in the face of rising temperatures, access to and benefits from these assets are not evenly distributed. A study by the Trust for Public Land found that, based on a dataset of 14,000 cities, towns, and census-designated places in the U.S., there is an uneven distribution of parks in communities by race, not only in terms of accessibility by distance, but in terms of the size of parks available to communities as well as how crowded these spaces are. [1] The report finds that "parks that serve a majority nonwhite population are, on average, half as large ... and nearly five times as crowded as parks that serve a majority-white population." This study also finds that "parks serving primarily low-income households are, on average, four times smaller — 25 acres versus 101 acres — than parks that serve a majority of high-income households."[2]

These smaller, more crowded parks provide lower cooling benefits as there is less temperature reduction through evapotranspiration and shade provision. More crowded conditions means that it will be more difficult for all users to access shade and use the park for refuge during hot days.

Interventions to address heat in parks and recreation spaces

While it may be difficult to develop large and spacious parks in dense urban communities, it is feasible to integrate design interventions in all park settings to maximize cooling benefits to the extent possible. Shade structures, increased greening and tree cover, and assets such as spray pools or public pools can all assist in enhancing the thermal benefits of parks and recreation spaces.

Without attempting to be comprehensive, we provide examples of design guidelines from selected cities and counties in California that include elements to minimize heat exposure and absorption in park settings. Table 4 includes relevant examples from six local jurisdictions.

[1] The Trust for Public Land. (2020). *The Heat is On.* https://www.tpl.org/sites/default/files/The-Heat-is-on_A-Trust-for-Public-Land_special-report.pdf
[2] Ibid.

Table 4: Examples of Heat-Related Design Requirements in Local Park Design Guidelines

Local Park Design Guidelines	Description of Heat-Related Design Requirements
2017 Los Angeles County Park Design Guidelines and Standards	**Plan includes comprehensive guidelines and recommendations around heat, including:** Guidelines for park buildings (including community, gymnasium, and pool buildings, etc.), which recommend consideration of building orientation (in response to climatic variables like solar heat), provision of air conditioning systems to provide emergency heat relief in the event of a heat wave, and consideration of placement, finish materials, and solar orientation to minimize heat accumulation during summer peak hours. Recommendations for reducing the heat island effect of parking lots, which include using cool and permeable pavements when possible, at least 50% shade coverage through tree canopy usage in parking areas within 15 years, and other specific shade tree specifications. Recommendations for shade covers, sails, and shelters for patrons within the park settings including baseball and softball fields, volleyball courts, basketball courts, futsal courts, skate parks, fitness zones, child play areas, splash pads, pools, and dog parks. Within the landscaping guidelines, the document recommends urban heat island effect reduction, shade production, and glare minimization by providing trees or vegetated structures adjacent to walkways, roofs, or parking lots.[3]
2020 Park Design Manual for County of San Diego	**Plan includes numerous amenity-specific guidelines to address heat, including:** Guidelines for providing tree canopy cover of at least 50% shade coverage in the open parking lot areas within 15 years. Recommendations for shaded seating within the specific park settings and amenities including open lawn areas, gymnasiums, ball fields, synthetic turf fields, basketball courts, volleyball courts, horseshoe pits, exercise/fitness areas, skate parks, and dog park areas. Recommendations for reducing the heat island effect, which include using cool and permeable pavements when possible, as well as providing trees or vegetated structures to shade walkways, roofs, or parking lots, and other specific shade tree and canopy specifications. Recommendation for shade incorporation over or located near benches where possible. Guidelines for green park buildings, which recommend consideration of building orientation to take advantage of prevailing winds and solar angle and light cool finish materials to minimize heat gain.[4]

[3] County of Los Angeles. (2017). Park Design Guidelines and Standards. http://file.lacounty.gov/SDSInter/dpr/1029701_ParkDesignGuideline2017.pdf

[4] County of San Diego Department of Parks and Recreation. (2020). Park Design Manual. https://www.sdparks.org/content/dam/sdparks/en/pdf/Development/Park%20Design%20Manual.pdf

Local Park Design Guidelines	Description of Heat-Related Design Requirements
2015 City of Irvine Park Standards	**Plan includes multiple specific and comprehensive guidelines and requirements to address heat, including:** General park amenity guidelines for shade structure for group recreation purposes with minimum 50% shade coverage. Shade structure requirements for pools and playgrounds, with goals for minimum 50% shade coverage over the pool deck and play equipment. In addition, the city outlines a time period for which all parks should have shade provided with either a structure or trees for playgrounds within five years of the park opening. Recommendation that trees for shade be located near accessible paths of travel when possible and consistent with the Irvine's Landscape Standards.[5]
2010 City of San Jose Urban Design Guidelines-Guidelines for Parks, Trails, and Open Space	**Plan includes multiple park type-specific heat intervention guidelines, including:** Broad guidelines for parks to provide immediate shade opportunities with shade structures and follow up with mature, large canopy trees. Neighborhood park guidelines for providing wind protection and shading in some areas, particularly at picnic facilities, through appropriate building placement, trees, landscaping, or shade structures. Community park guidelines to provide trees and shade structures, particularly in picnic areas and by play areas. Central urban parks guideline to provide shade structures for day-to-day use.[6]
2021 City of Vacaville Parks and Recreation Master Plan Draft - Park Development Guidelines	**Plan includes limited guidelines and recommendations to address heat, including:** Minimum park feature guidelines requiring shade trees, structures, or canopies for picnic areas and park features. A recommended goal to "plant more trees in urban parks for shade, beauty, climate adaptation benefits, and reduced heat island effects."[7]
2018 City of Gilroy Parks and Amenities Design Guidelines	**Plan includes limited requirements and less stringent guidelines to address heat, including:** A broad recommendation for shade at playgrounds as a priority "whenever possible." A requirement for shade trees and trellis structures for neighborhood and community parks, as well as a recommendation for miniparks to provide shade and protection from the sun.[8]

[5] City of Irvine. (2015). *Park Design Standard*s. https://www.cityofirvine.org/development-engineering/design-manuals

[6] City of San Jose. (2010). North San Jose Urba*n Design Guidelines*. https://www.sanjoseca.gov/home/showpublisheddocument?id=15619#page=113

[7] City of Vacaville. (2021). Vacaville Parks and Recreation Master Plan. https://www.ci.vacaville.ca.us/home/showpublisheddocument?id=17256#page=79

[8] City of Gilroy. (2018). *Parks and Amenities Design Guidelines*. http://www.ci.gilroy.ca.us/DocumentCenter/View/8501/Park-and-amenities-design-guidelines-05-09-2018

Responsible state agencies

A focus on parks and open space highlights the limitation of this report's exclusive focus on state agencies and our exclusion of local governments. Only a small, but still important, number of urban and suburban parks are managed by the California Department of Parks and Recreation. These do tend to include some of the largest parks in urban or urban-adjacent locations.

However, the vast majority of parks are not overseen or managed by state agencies. According to data from the California Department of Parks and Recreation's Comprehensive Outdoor Recreation Plan (SCORP), there are 3,332 county parks and 18,086 city parks throughout the state.[9] For parks managed by local jurisdictions, design guidelines referencing heat-relevant requirements (e.g., requirements related to shade; tree canopy; use of building materials such as cool pavement or cool roofs; structural orientation of buildings to reduce heat accumulation) are overseen by local agencies not state agencies.

State laws and regulations

We were not able to identify any state guidelines requiring interventions for heat exposure or heat risk mitigation in urban parks and recreation facilities.

State funding opportunities

We identified eight state programs that can be used to address the issue of heat exposure in parks and recreation spaces through investments such as tree planting and building features such as cool roofs and shade structures to enhance thermal comfort for users. So, although the state does not provide oversight or guidance for local park availability to design, it is incentivizing local heat-relevant investments in local parks and open space. As shown in **Table 5,** various heat-relevant interventions are supported by these programs for parks and recreation spaces, including urban greening, cool roofs, and shade structures.

When reviewing the objectives of these programs, we found that the programs had a variety of different objectives, including greenhouse gas emissions reductions, improving public health, providing environmental benefits, recreational benefits, and/or improving economic conditions of communities.

However, none of the programs identified the objective of addressing extreme heat as a primary objective. Two programs, UCF and UG, considered urban heat island reduction to be a co-benefit and would allot points to projects if the applicant could demonstrate this benefit. In other programs (SPP, RPP, RRT), reducing urban heat island effects was considered to be one of many techniques that can be used by projects to enhance their environmental design; a minimum of three or more of these techniques are needed to obtain maximum points for the "Environmental Design" component within the project selection criteria. Similarly, the EEM program gives points to applications that can demonstrate ways in which a project can increase a region's adaptability to climate change; however, the issue of heat is not explicitly mentioned. Additional details on programs and their stated objectives can be found in Table C2 in Appendix C.

The TCC program is unique in that climate adaptation and resiliency considerations must be taken into account and integrated into the application. Specifically, applicants must identify climate change risks and exposures (e.g., additional days of extreme heat)

[9] California Department of Parks and Recreation. (n.d.). *Park Access Tool*. Accessed April 2021 on https://www.parksforcalifornia.org/parkaccess/?overlays1=parks%2Cnoparkaccess&overlays2=parks%2Cparksper1000.

Table 5: State Funding Programs for Heat Risk-Reduction Interventions in Public Parks and Spaces

State Programs / Funding Resources	Utility Financial Assistance	AC Replacement / Repair	Weatherization	Urban Greening	Cool Roofs	Shade Structures	Solar PV	Plans to Address Extreme Heat
Urban and Community Forestry Program (UCF)				X				
Urban Greening (UG)				X				
Environmental, Enhancement & Mitigation Program (EEM)				X				
Statewide Park Development and Community Revitalization Program (SPP)				X	X	X		
Regional Park Program (RPP)				X	X	X		
Rural Recreation, Tourism and Economic Enrichment Investment Program (RRT)				X	X	X		
Recreational Infrastructure Revenue Enhancement Program (RIRE)				X	X	X		
Transformative Climate Communities Program (TCC)		X	X	X	X	X	X	X

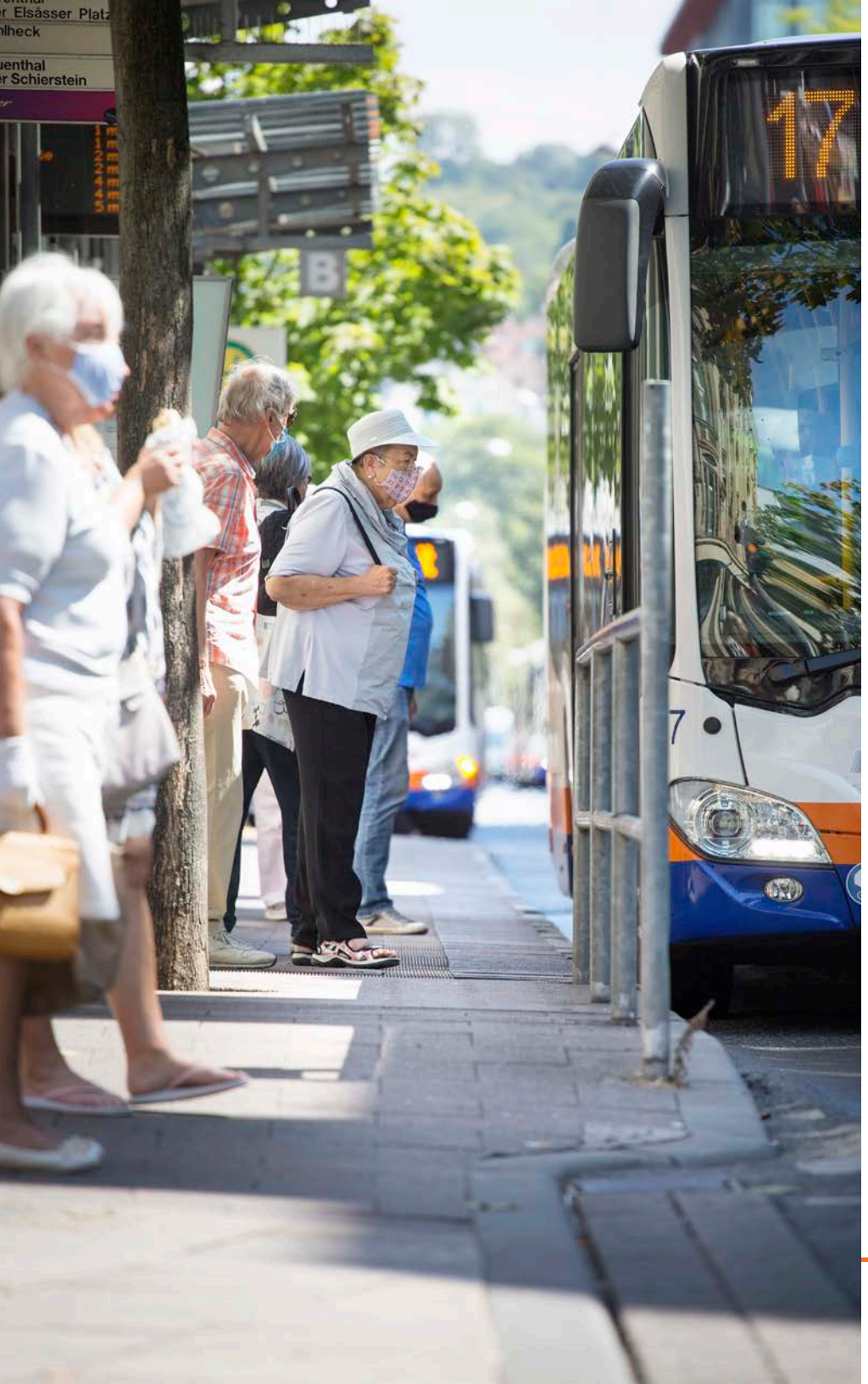
within the proposed project area, how these may affect the community, and how the proposed project will increase the resiliency of the project area to these anticipated impacts. While the program is not explicitly designed to address heat, this application requirement opens opportunities to integrate heat adaptation considerations into the project. For the RIRE program, the issue of heat was not mentioned.

Heat Considerations for Formal Program Eligibility or Funding Allocation. We reviewed programs to understand whether the issue of extreme heat (i.e., current or projected temperatures or extreme heat days) was used to determine program eligibility or funding allocation. We found that no programs set program eligibility parameters to focus on areas with high heat risks, nor did any programs have requirements around allocating a selected percentage of program funds to areas with high anticipated heat risks.

In terms of geographic eligibility criteria, programs were either required to be implemented in urban areas (UCF, UG); rural areas (RRT); areas with low park space or low median household income (SPP); areas meeting selected thresholds using CalEnviroScreen rankings or median household income (TCC); jurisdictions that had

obtained voter approval for revenue enhancement measures related to park infrastructure (RIRE); or statewide (EEM, RPP). Additional details can be found in Table C4 in Appendix C.

In terms of funding allocation prioritization, several program guidelines identified percentages of funding that the program was required to or intended to allocate to specific communities; the majority of these were based on CalEnviroScreen or median household income of communities. None mentioned climate conditions or used this as a basis for considering funding allocation.



Chapter 9: Public Transit Stops

HEAT EXPOSURE CAN OCCUR for public transit users while waiting for buses or above-ground rail transit. Transit-dependent populations such as those without private transportation, older adults, youth, and low-income individuals are at particular risk of experiencing heat exposure from this setting.[1] A 2018 study that analyzed 2013 California Household Travel Survey (CHTS) for the Southern California Association of Governments (SCAG) region found that individuals in households without a vehicle were about five times as likely to use public transit as those in households with a vehicle.[2]

The COVID-19 pandemic has shown that those who rely on transit likely have underlying socioeconomic conditions that make them vulnerable to not only adverse heat-related impacts from exposure during transit but also other possibly compounding health risks. An analysis of transit usership in 2020 by the app Transit found that those who continued to rely on transit were largely essential workers using public transit to commute to work. Older riders, individuals over 45 years old, also indicated higher levels of continued

[1] Grengs, J., Levine, J., & Shen, Q. (2013). *Evaluating transportation equity: An intermetropolitan comparison of regional accessibility and urban form* (No. FTA Report No. 0066). United States. Federal Transit Administration. Office of Civil Rights.

[2] Manville, M., Taylor, B. D., & Blumenberg, E. (2018). Falling transit ridership: California and southern california. *Southern California Association of Governments.* http://scag.ca.gov/Documents/ITS_SCAG_Transit_Ridership.pdf.

transit use throughout the early stages of the pandemic.[3]

Interventions to address heat at public transit stops

Relevant interventions to mitigate heat or reduce heat-related risks at transit stops include installing shade structures at wait stops and providing transit users with accurate information around when vehicles are expected to arrive.[4] Providing water through drinking fountains placed near transit stops is another way to assist transit users. Informing transit users about the risks of heat illness, and encouraging them to notice warning signs and to take preventative behaviors are also important.

Responsible agencies

Public transit stops are a setting for which local transit agencies and governments bear greater responsibility for designing and implementing interventions over state agencies.

According to the 2018 National Transit Database (NTD), there are 215 transit agencies in California.[5] These agencies include independent public agencies or authorities, city, county or local government units, universities, tribes, and private corporations. Transit agencies have authority over land and assets that are agency property; however, sidewalk and street spaces often fall under the authority and ownership of local governments. Thus, building a shade structure near a transit stop requires permission and often investments or cost-sharing by city or county governments.[6] In some cities, such as Los Angeles, partnerships with advertising companies have also informed the development and location of transit shade structures.[7, 8]

State laws and regulations

We were not able to identify any state regulations for limiting heat exposure for those waiting for transit vehicles. Federal Americans with Disabilities Act (ADA) Standards for Accessible Design guidelines have requirements for bus stop clearance, bus stop amenities such as benches, and shelter accessibility, but none related to shade provision. [9]

State funding opportunities

We identified six state programs that can be used to address the issue of heat exposure in the transit stop setting, as shown in **Table 6.**

As in the table, the most relevant heat risk-reduction measure fundable through programs was shade structures, which almost all programs fund. Besides shade structures, some programs provide

[3] Liu, L., Miller, H. J., & Scheff, J. (2020). The impacts of COVID-19 pandemic on public transit demand in the United States. *Plos one*, *15*(11), e0242476.

[4] Mass Transit. (2016). *Shelters Help Improve Ridership During Extreme Heat and Cold.* https://www.masstransitmag.com/bus/press-release/12284922/urban-transportation-center-at-the-university-of-illinois-at-chicago-utc-shelters-help-improve-ridership-during-extreme-heat-and-cold

[5] California Integrated Travel Project. (2020). *Analysis of Proposed Cal-ITP Initiatives: A Feasibility Study*. https://dot.ca.gov/-/media/dot-media/cal-itp/documents/cal-itp-feasibility-study-042420-a11y.pdf

[6] TransitCenter. (2018). *From Sorry to Superb: Everything You Need to Know about Great Bus Stops.* https://transitcenter.org/wp-content/uploads/2018/10/BusReport_Spreads.pdf

[7] Barragan, B. (2019). *6,000 bus stops in Los Angeles lack shelter.* Curbed Los Angeles. https://la.curbed.com/2019/8/21/20802678/los-angeles-heat-metro-bus-stops-shade

[8] TransitCenter. (2018). *From Sorry to Superb: Everything You Need to Know about Great Bus Stops.* https://transitcenter.org/wp-content/uploads/2018/10/BusReport_Spreads.pdf

[9] Bus boarding including street and bus shade specifications found in 810 Transportation Facilities section (215). https://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards_prt.pdf

Table 6: State Programs That May Fund Interventions at Transit Stops

State Programs / Funding Resources	Utility Financial Assistance	AC Replacement / Repair	Weatherzation	Urban Greening	Cool Roofs	Shade Structures	Solar PV	Planning to Address Extreme Heat
Active Transportation Program (ATP)						X		X
Low Carbon Transit Operations Program (LCTOP)						X		
CalSTA: Transit and Intercity Rail Capital Program (TIRCP)						X		
Caltrans: State Transportation Improvement Program (STIP)						X		
Caltrans Transportation Planning Grant Program – Sustainable Communities and Strategic Partnerships Grant								X
Transformative Climate Communities Program (TCC)		X	X	X	X	X	X	X

funding for other measures. The ATP also provides recipients with the opportunity to develop communitywide bicycle, pedestrian, safe routes to school, or active transportation plans, which could include discussions around heat risk reduction. The TCC program can also be used for a host of other heat risk-reduction measures such as urban greening, cool roofs, and solar PV.

The Caltrans Transportation Planning Grant Program, the only program not to provide funding for shade structures, can be used to develop climate change adaptation plans for transportation facilities, or to support studies, plans or planning methods that advance a community's effort to address the impacts of climate change.

The objectives of these six programs include greenhouse gas

emissions reductions, expanding and improving transit service to increase ridership, improving transit safety, and providing public health and environmental benefits, among others. While the issue of heat is one that can be addressed using these programs, they are not explicitly discussed in most program guidelines (ATP, TIRCP, STIP, Caltrans Transportation Planning Grant Program).

Heat considerations for program eligibility or funding allocation. We reviewed programs to understand whether the issue of extreme heat (i.e., current or projected temperatures or extreme heat days) was used to determine program eligibility or funding allocation. We found that no programs explicitly set program eligibility parameters to focus on areas with high-heat risks, nor did they have any requirements for allocating a selected percentage of program funds to areas with high anticipated heat risks.

In terms of geographic eligibility criteria, the six reviewed programs could be accessed by applicants statewide. In terms of funding allocation prioritization, five out of six programs identified funding allocation priorities; of these, three programs (LCTOP, TIRCP, TCC) based prioritization on Disadvantaged Communities (defined as census tracts in the top quartile of CalEnviroScreen 3.0 scores) or low-income communities based on requirements established in AB 1550. The ATP program and Caltrans Sustainable Communities and Strategic Partnerships Grant used broader categories. For instance, the ATP program allows applicants to define project areas as being within a disadvantaged community based on having at least 75% of public school students in the project area eligible to receive free or reduced-price meals under the National School Lunch Program; being in the 25th percentile or less in the Healthy Places Index; being located within Federally Recognized Tribal Lands; in addition to CalEnviroScreen-related metrics or income-related metrics. Applicants could also use other indicators for consideration by reviewers. For the Sustainable Communities Competitive Grant, the program goal is for 50% of grants to benefit Disadvantaged Communities, which can be defined in various ways, e.g., using CalEnviroscreen, AB1550 communities, Healthy Places Index, or other metrics. Additional details can be found in **Table C4** in Appendix C.

Chapter 10: State Governance of Local Adaptive Efforts

WHEN AND HOW SHOULD STATE AGENCIES influence the development of local governments' heat exposure guidelines? Based on our analysis, this question cannot be answered in a general or generic way — it depends on the specific exposure setting. This is because the way state and local governments share policymaking responsibility varies greatly across exposure settings.

There are some settings in which heat risks are determined primarily by local government policymaking in the form of *local building codes* and the design guidelines that are informed by *local general plan elements*. For example, the structural capacity of homes, most indoor workplaces, as well as day care and senior care facilities to provide protective thermal conditions depends largely on local building and landscaping codes. In other exposure settings, such as most parks, open spaces, transit stops, and sidewalks, the presence of best available cooling designs and technologies depends on local design standards and codes, which may be influenced by general plan elements.

However, just because the building codes and general plans are

adopted and implemented at the local level, does not mean that the state cannot influence their development in several ways. In this chapter we briefly review the current state of building codes for the priority exposure settings that we have examined. We also examine broader state efforts to encourage local planning and general plan evolution to address climate impacts.

California building code requirements

At the state level, the California Code of Regulations Title 24, also known as the California Building Standards Code, is the minimum standard for the design and construction of buildings and structures throughout the state. It is maintained by the California Building Standards Commission and is updated every three years.

Title 24 includes California's Building Energy Efficiency Standards, which is updated by the California Energy Commission (CEC) every three years. It includes requirements for building features, including the building envelope (e.g., windows, roofing, insulation) to ensure a minimum standard of energy efficiency for newly constructed buildings. These requirements also apply to additions and alterations on existing buildings.

Title 24 also includes the California Green Building Standards Code (CalGreenCode) which applies to newly constructed buildings and includes provisions on the design and construction of buildings to reduce negative environmental impacts or advance positive impacts.[1]

The following are sections in Title 24 that focus on either maintaining indoor temperatures to ensure thermal comfort or reducing the urban heat island effect:

- **Cool roof requirements:** As of 2019, Title 24's California's Building Energy Efficiency Standards includes requirements for roofing materials used in newly constructed buildings, building retrofits, or building additions that affect 50% or more of a roof (or exceed a minimum area defined for residential and nonresidential buildings). Roofing materials used in these circumstances must meet either minimum requirements for thermal emittance and three-year aged solar reflectance, or minimum Solar Reflectance Index (SRI) requirements. This applies to low-rise residential, high-rise residential, and nonresidential buildings.[2]
- **Reducing heat island effect created by non-roof surfaces (voluntary):** The CalGreenCode includes a section on reducing heat island effect for nonroof areas such as sidewalks, patios, driveways, or other paved areas. It encourages use of trees to provide shade, using high albedo materials, locating parking underground or using multilevel parking, among other recommendations for addressing heat exposure in nonroof settings.[3] It is important to note that these are voluntary measures for residential settings. Similarly, voluntary measures are suggested for nonresidential buildings.[4]
- **Indoor temperature requirements:** Title 24 requires that "interior spaces intended for human occupancy shall be provided with active or passive space heating systems capable of maintaining an indoor temperature of not less than 68 F (20°C)." [5] While it includes this requirement to ensure that building interiors can be

[1] California Code of Regulations, Title 24, Part 11
[2] California Code of Regulations, Title 24, Part 6
[3] California Code of Regulations, Title 24, Part 11, Appendix A4, Section 106.7
[4] California Code of Regulations, Title 24, Part 11, Appendix A5, Section 106.11
[5] California Code of Regulations, Title 24, Part 2, Section 1203.1

made sufficiently warm for occupants, no such requirement exists for maintaining sufficiently cool temperatures.

- **Energy Code:** Part 6 of Title 24 features California's Energy Code, which is "designed to reduce wasteful and unnecessary energy consumption in newly constructed and existing buildings."[6] The Energy Code includes sections focused on the building envelope (e.g., insulation, materials for windows, and roofs) for residential and nonresidential buildings. By enhancing the thermal performance of buildings, these requirements may also improve thermal comfort and safety conditions for occupants. However, the ultimate defined purpose of these code requirements is to reduce energy consumption.

The Building Standards Code must be enforced by local governments, which may also adopt additional, more stringent standards based on local climatic, geological, or topographical conditions. For selected occupancy types (such as hospitals, state buildings, public schools, and others), the standards are subject to enforcement by state agencies.

The California Buildings Standards Commission is the primary body responsible for overseeing activities to adopt and publish Title 24 standards. It leads this process in collaboration with multiple other state agencies and representatives from relevant public parties (e.g., advocacy groups, local government entities) seated within advisory committees relevant for various code parts and/or subject matter.[7] Select state agencies also have the authority to propose building standards for integration into Title 24 for relevant settings. For instance, the Office of Statewide Health Planning and Development may propose standards for facilities such as hospitals and skilled nursing facility settings.[8]

State planning mandates for local governments

SB 379, adopted on October 8, 2015, requires cities and counties to review and update the safety elements of their general plans to address climate adaptation and resiliency strategies relevant to the jurisdiction. This was required beginning January 1, 2017 (or January 1, 2022 for cities that have not yet adopted a local hazard mitigation plan).

Reviews of the safety element must include:

1) a vulnerability assessment that identifies risks that climate change poses to the jurisdictions and geographic areas at risk from climate impacts; information on historic and projected climate conditions as well as information on sensitive assets, resources, and populations, among other data;
2) a set of adaptation and resilience goals, policies, and objectives based on a vulnerability assessment for the protection of the community; and
3) a set of feasible implementation measures, including, among others, methods to avoid or minimize climate impacts associated with new uses of land, measures to locate essential public facilities outside at-risk areas, and the identification of natural infrastructure that may be used in adaptation projects, where feasible.

[6] California Energy Commission. (n.d.). *Building Energy Efficiency Standards - Title 24.* https://www.energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards
[7] California Code of Regulations, Title 24, Part 1, Chapter 1 Administrative Regulations of the CBSC
[8] California Code of Regulations, Title 24, Part 1, Chapter 7 Safety Standards for Health Facilities

For jurisdictions that have adopted a local hazard mitigation plan or another climate plan or document that fulfills requirements, this information may be integrated into the safety element or referenced within. The **CalOES Adaptation Planning Guide** provides step-by-step guidelines to local governments planning for climate adaptation.

In 2018, SB 1035 revised requirements established by SB 379 by requiring that after 2022, cities and counties must revise general plan safety elements to identify new information on fire hazards, flood hazards, and climate adaptation and resiliency strategies applicable to the jurisdiction that were not available during the previous revision of the safety element. This review and, if necessary, update must take place during the revision of the housing element or the local hazard mitigation plan, but not less than once every eight years.

The state's guidance on broader climate planning and adaptation

California's climate adaptation strategy is outlined in the **Safeguarding California Plan**. The plan includes a number of policy recommendations relevant for mitigating extreme heat risk across policy sectors, including public health, emergency management, land use and management, transportation, and parks and recreation. Updates on the status of these activities are not yet publicly available.

In **Preparing California for Extreme Heat** (2013), Cal/EPA and CDPH outline in very broad brush strokes the mitigation strategies involving built environment changes, extreme heat event preparedness and response planning, public health and health care sector readiness, worker protection, and further research needs. Neither the **Safeguarding California Plan** nor **Preparing California for Extreme Heat** set specific goals with metrics for heat mitigation and heat risk reduction in the State of California (e.g., heat illness reduction, Urban Heat Island Reduction).

Chapter 11: The Role of State vis-a-vis Local Government in Preparing for Heat Emergencies

WHEN TEMPERATURES EXCEED LIMITS that are consistent with historic averages over a prolonged period, governments can declare heat emergencies that trigger a recognition that some people will need to change their behavior to avoid heat-related harms.

In this chapter, we review California's emergency management and public health interventions to prepare for and respond to heat emergencies, such as disseminating preventative information; activating cooling centers and providing transportation services to centers; and contacting, monitoring, and/or directly assisting at-risk populations.

Federal and state policymaking for heat emergencies

When heat temperatures reach certain thresholds, the federal National Weather Service alerts local emergency management de-

partments; the decision to issue a heat alert and take subsequent actions is a local decision. Though notification of extreme heat can make people more aware of hazardous health conditions, a study of NWS heat alerts between 2001 and 2006 showed that they did not lessen mortality rates.[1]

At the state level, the California Office of Emergency Services (CalOES) is responsible for communicating and coordinating with other state agencies and local governments to prepare for and respond to heat-related emergencies. In CalOES' Contingency Plan for Excessive Heat Emergencies, it outlines its own roles and responsibilities, as well as those of other state agencies, NGOs, commissions, private entities, and federal agencies. It identifies and focuses on three particular phases: 1) seasonal readiness, 2) heat alert, and 3) heat emergency. [2] The plan also provides recommendations to local governments on how to prepare for and respond to extreme heat events.[3]

While CalOES provides guidelines on how local jurisdictions can prepare for and respond to extreme heat, these are recommendations and not requirements. Local health departments and emergency management offices have direct oversight and are largely responsible for developing their own approaches to responding to heat emergencies.[4] A 2016 report by the consulting firm Four Twenty Seven found that there are high levels of variation in readiness and capacity across jurisdictions when it comes to preparing for extreme heat. Informed by public health and emergency preparedness stakeholders across the state, it noted that county-level offices of emergency management generally lead heat emergency management efforts, and county health departments play supporting roles by conducting outreach and communications to vulnerable populations and by tracking reported health outcomes.

However, there are differences in local roles and responsibilities, based on existing departmental structures. Further, the report notes that each county differs in the level of resources and capacity it has to respond to heat events; while some are equipped to open cooling centers and provide transportation to these centers, others do not have the funds to provide such resources. Each jurisdiction's capacity to plan for, prepare for, and respond to extreme heat is largely dependent on the funding and staff capacity available in the local government to address this issue.[5]

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[1] Weinberger, K. R., Zanobetti, A., Schwartz, J., & Wellenius, G. A. (2018). Effectiveness of National Weather Service heat alerts in preventing mortality in 20 US cities. *Environment international*, *116*, 30-38.

[2] While the seasonal readiness phase is activated during hotter months (May through August), the heat alert phase is activated based on National Weather Service (NWS) alerts; the heat emergency phase is activated when conditions in one or more of the state's operational areas pose a severe threat and one or more particular conditions are met (e.g., abnormal animal mortality rates due to heat; abnormal human medical emergencies due to heat).

[3] California Governor's Office of Emergency Services. (2014). *Contingency Plan for Excessive Heat Emergencies.* https://www.caloes.ca.gov/PlanningPreparednessSite/Documents/ExcessiveHeatContingencyPlan2014.pdf

[4] Four Twenty Seven. (2016). *California Heat & Health Project A Decision Support Tool.* http://427mt.com/wp-content/uploads/2017/01/427_CA_HeatHealth_DecisionTool_UserNeedsAssessment-1.pdf

[5] Ibid.

Chapter 12: Summary of Policy Gaps and Related Findings

IN THIS WORK WE AIM to understand what state-level regulations, planning efforts, and funding opportunities exist to address heat in selected settings in California, and who has oversight of these activities. We hope that this descriptive exercise is a helpful step toward understanding what and where ongoing efforts exist and what gaps could be filled to protect individuals and communities from adverse heat impacts, as well as moving toward the establishment of a regulatory framework to address heat-related risks in California.

There is no centrally responsible authority to provide technical assistance, strategic funding, or coordination to sister agencies to address the issue of heat. When reviewing state entities with oversight for ensuring thermal safety, it was clear that there were numerous agencies with various types of regulatory responsibilities, creating a varied landscape when it comes to addressing the heat. For selected settings (i.e., outdoor workplaces, child care centers, senior living facilities), there are designated agencies such and Cal/OSHA, CDSS, and CDPH that are responsible for monitoring heat safety requirements and/or checking that temperature thresholds are met within facilities. For managing heat emergencies, CalOES provides coordination at the state level, though local jurisdictions largely have oversight on how to pre-

pare for and respond to extreme heat events. Ultimately, there is no centrally responsible state authority overseeing strategies and activities related to the issue of heat throughout the state.

A coordinating agency dedicated to addressing the issue of heat could be valuable in providing leadership on the following types of activities:

1) Supporting the design, development, and implementation of statewide heat risk-reduction policies
2) Supporting the development of statewide goals and metrics for heat risk reduction and adaptation
3) Providing guidance to local governments on heat risk-reduction interventions
4) Leading interagency coordination among various sister agencies with regulatory oversight on heat exposure for selected population groups or settings
5) Administering funding for heat risk-reduction investments
6) Promoting public education around heat risks
7) Coordinating research on the impacts of heat exposure and potential strategies and interventions

Most existing heat-exposure standards are inadequate or have limited compliance reporting. When reviewing existing regulations on heat exposure in selected high-priority settings, we found that there were several settings that have no requirements to protect potentially heat vulnerable or at-risk individuals from heat exposure.

For residential settings, there are neither technology nor performance heat standards. While the state building code requires residences to be able to reach a minimum target temperature that is sufficiently warm (68 degrees F), no comparable requirement exists to keep indoor temperatures sufficiently cool for occupants. This is particularly concerning for particularly heat-vulnerable population groups, such as older adults (who are increasingly choosing to age-in-place at homes instead of dedicated facilities), individuals with disabilities and/or limited mobility, and youth and infants — all of whom spend significant periods in the residential setting. It is also particularly concerning for low-income households.

Similarly, we found that no state-level indoor temperature requirements exist for schools. While some school districts have developed heat illness prevention guidelines and protocols, there is no requirement for all schools to prepare this type of heat-specific protocol document.

Prisons and correctional facilities are another setting in the state for which there are no requirements around thermal comfort and safety.

In the context of outdoor public spaces, improving thermal comfort in public spaces such as parks, recreation spaces, and in transit stations through use of shade or other interventions is currently driven by local jurisdictions and affiliated agencies. There are no state-level guidelines or requirements to prevent heat exposure in these spaces.

Most *existing* state programs do not make investments that explicitly target heat-vulnerable places or quantify heat risk-reduction benefits. We reviewed over 20 programs[1] overseen by 10 different state agencies that channel funding for heat-rele-

[1] We reviewed programs that were offered in 2020 and 2021, or were anticipated to be offered in 2021 as of March 2021.

vant measures[2] into several of the priority settings we identified. We found that most existing state programs that could be used to address the issue of heat in some way are not explicitly designed to center heat risk reduction as a primary program goal. They also do not explicitly target program fund delivery to heat vulnerable places (e.g., based on projected temperatures, extreme heat days or events). Only two programs, the Low Income Home Energy Assistance Program and the Weatherization Assistance Program, use a heat-relevant metric (cooling degree days) to inform funding allocation decisions for weatherization services and energy bill pay assistance.

CalEnviroScreen or community median income values are often used by many agencies to prioritize funding allocation. However, these do not necessarily recognize areas with high risks of extreme heat days or heat vulnerability.[3] While several programs we reviewed discussed heat-related co-benefits that could be created by the program (e.g., reducing urban heat island effect), we could not identify any programs that seem to evaluate or track the effect of these investments on the issue of heat.

Future funding opportunities to address the issue of heat should include heat-specific mitigation and/or risk-reduction objectives, metrics, as well as funding allocation guidelines to identify and support heat vulnerable population groups and communities.

Local hazard planning efforts may not be preparing cities adequately for extreme heat. Local governments are beginning to integrate consideration of extreme heat into local planning efforts. By 2022, state laws (SB 379, SB 1035) require that local governments update the safety elements of their general plans to address climate adaptation and resiliency needs. These plans should respond to climate impacts, including increased heat exposure. Some heat-related guidance documentation does exist to support these planning processes, such as the California Adaptation Planning Guide. However, in the context of planning for heat adaptation, the following gaps still seem to exist, which may limit local governments' ability to implement interventions:

- **More unified guidance on definitions, goals, and metrics as relates to heat**, such as different types of temperature measurements (e.g., air and surface temperature, heat index, mean radiant temperature, different ways of defining heat waves), as well as possible goals and metrics that should be established to track progress toward heat mitigation or risk reduction (e.g., ER visits for heat, UHI reduction, percentage of tree cover).
- **Dedicated funding opportunities** with designated suite of heat mitigation and risk-reduction measures for use by local jurisdictions.
- **Readily accessible information on the efficacy and applicability of different interventions** in mitigating heat or affiliated risks, particularly based on local climate conditions, as well as neighborhood (microscale) climate conditions.
- **Information on trade-offs between certain strategies** (e.g., tree planting impacts on water)

Further, while general plan updates will be a helpful first step toward understanding climate hazards in a region, the implementation of heat-reduction strategies will require further investments for training, staff capacity, and funding to implement interventions.

[2] Home weatherization, urban greening, solar PV, cool roofs, shade structures, air conditioning replacement or repair, planning efforts to address extreme heat, or utility bill pay assistance

[3] Turek-Hankins, L. L., Hino, M., & Mach, K. J. (2020). Risk screening methods for extreme heat: Implications for equity-oriented adaptation. *Plos one*, *15*(11), e0240841..

Without dedicated state financing assistance, similar planning mandates have led to inequalities in governance capacity as better-resourced communities are more likely to train staff, plan and coordinate across collaborating agencies than lower-income communities.

As of October 2021, the state budget includes $800 million of funding to address extreme heat between 2022 and 2024, that will include the development of a new community resilience and heat grant program, in addition to other activities. We hope this future funding, in addition to other investments in local government capacity building, can be used to help fill some of the gaps identified in this report.

Improving thermal comfort in public spaces and reducing urban heat island effects rely largely on voluntary state guidance. As of 2019, California's Building Energy Efficiency Standards includes requirements for the use of cool roofing materials. However, these are only for newly constructed buildings, retrofits, or additions. The CalGreenCode includes various other measures to address the thermal emittance of built materials, cool surrounding environments, and reduce the urban heat island effect; however, it is important to note that these are voluntary. Local jurisdictions may also consider adopting recommendations on the use of trees to provide shade, using high albedo (reflective) materials, locating parking underground or using multilevel parking, among other measures in residential and nonresidential buildings. However, such voluntary standards are unlikely to be adopted in communities—particularly moderate- and low-income communities, in the absence of readily accessible state funding or incentives and guidelines to address the issue of thermal comfort and extreme heat. This is of particular concern as these communities often have lower green space and tree canopy per capita and higher percentages of low-income residents reliant on public transit, making them more vulnerable to adverse heat impacts.

Appendix A:
American Time Use Survey Analysis Methodology and Results

The American Time Use Survey (ATUS), administered by the U.S. Census Bureau for the Bureau of Labor Statistics, provides nationally representative estimates of how and where Americans spend their time.[1] ATUS respondents are selected based on participation in the Census Bureau's Current Population Survey (CPS) and demographic information. Participants must be at least 15 years old and are interviewed about their activities within a 24-hour period on a specific day. ATUS results are published annually.

For this analysis, 2003-2018 ATUS data are used to estimate the average amount of time (in hours) individuals spend at various locations. Specifically, three datasets were used:

1) **ATUS 2013-18 Activity** file contains daily activity information for each respondent, including where the activity took place. The location variable (TEWHERE) is not collected for private activities such as sleeping. For these activities, an indoor location is assumed.[2]
2) **ATUS 2013-18 Roster** file contains key demographic information for each individual, such as age and sex. For 2003-2004, the age variable (TEAGE) is set at a maximum of 80, but for 2005-2018 it is set at 85.[3]
3) **ATUS 2013-18 Respondent** file contains a variety of information relating to each respondent, such as employment status and number of children. A critical variable in this file is TUFNWGTP, which assigns a weight to each respondent to correct for bias. Specifically, these weights are meant to ensure that demographic groups are equally represented and days of the week are proportioned correctly.[4]

Stata was used for all data analysis. First, all three files were merged into one comprehensive dataset. Next, the data was filtered into subpopulations based on day of the week, sex, age, employment status, and age of the youngest household child. Across subpopulations, individual weights (TUFNWGTP variable) were used to compute the weighted number of minutes spent in each location, for each respondent. From these weighted values, the average number of minutes spent in each location is calculated and converted to hours.

[1] U.S. Bureau of Labor Statistics. (2018). *American Time Use Survey.* https://www.bls.gov/tus/atusfaqs.htm#1
[2] Ibid.
[3] U.S. Bureau of Labor Statistics. (2019). *American Time Use Survey (ATUS) Data Dictionary: 2003-18 Interview Data*. https://www.bls.gov/tus/atusintcodebk0318.pdf#page=11
[4] U.S. Bureau of Labor Statistics. (2020). *American Time Use Survey User's Guide: Understanding ATUS 2003 to 2019*. https://www.bls.gov/tus/atususersguide.pdf#page=34

Results

Results show that respondents spend 23.27 hours/24 hours on an average day at the following top 10 identifiable locations (in descending order): respondent's home, yard, or unspecified indoor location for sleeping, grooming, personal activities; respondent's workplace; transportation; restaurant/bar/grocery store/other store; someone else's home; school; outdoors away from home; place of worship; gym/health club; and library (see **Table A1**, right).

We also examined where selected subpopulation groups, older adults (65+), youth, and full-time workers tend to spend time (see **Figure A1,** next page).

Older Adults[5]

Those 65-75 and 75+ spend more time at their home (almost double that of respondents age 15-18), and "place of worship" than average.[6] Respondents age 65+ also spend more time in the "other place" category — activities within this category involve medical care services, socializing/leisure, light sports, and volunteering.

Youth

Outside the home, youth (age 15-18) tend to spend most time in schools on weekdays, followed by time in transit; in someone else's home; respondent's workplace; and "other places." The activities conducted in "other places" include engaging in entertainment and arts (e.g., attending movies, arts, television), socializing with others, and more strenuous sports than those reported for older adults (e.g., basketball, water sports, soccer).

Full-time Workers

We found that full-time employed persons working on weekdays spend 7.13 hours on average at their workplace.

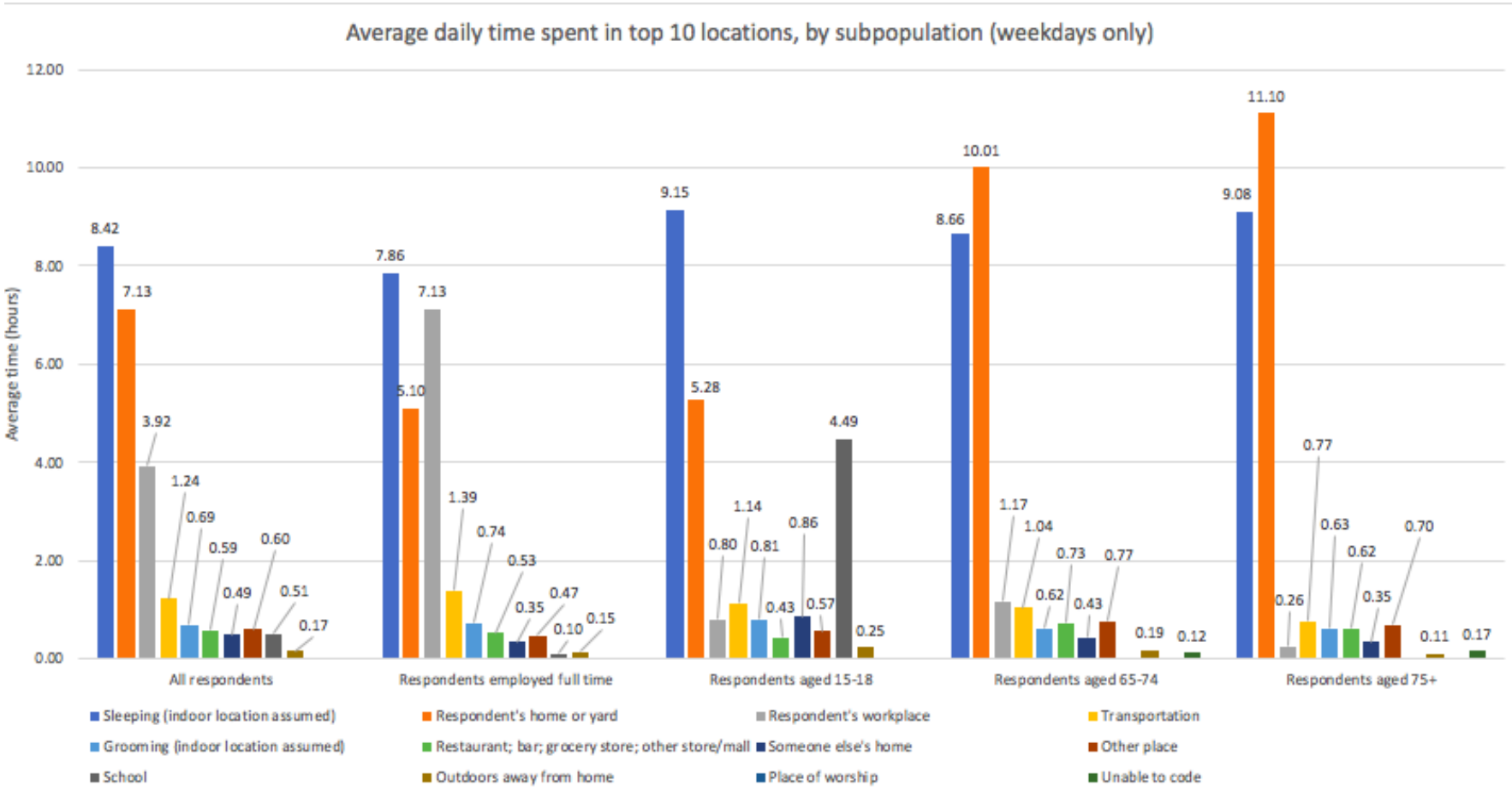
Table A1: Average Number of Hours per Day Spent in Selected Locations by Respondents to the American Time Use Survey (2003-2018)

All Respondents	
Grouped Location	**Avg. Hours/Day**
Indoor location (assumed for sleeping, grooming, personal activities) or respondent's home or yard	16.85
Respondent's workplace	3.05
Transportation (i.e., car; truck; motorcycle; walking; bus; subway/train; bicycle; boat/ferry; taxi/limousine; airplane; or other mode)	1.22
Restaurant; bar; grocery store; other store/ mall	0.67
Someone else's home	0.67
Other place	0.64
School	0.38
Outdoors away from home	0.20
Place of worship	0.16
Unable to code	0.07
Gym/health club	0.05
Unspecified place	0.02
Library	0.02
Bank or post office	0.01
Unknown location	0.00
Sum (top 10 identifiable locations)	**23.25**
Sum (total)	**24.00**

[5] The ATUS does not include people residing in nursing homes.

[6] U.S. Bureau of Labor Statistics. (2020). *American Time Use Survey User's Guide: Understanding ATUS 2003 to 2019*. https://www.bls.gov/tus/atususersguide.pdf#page=11; the ATUS does not include people residing in nursing homes.

Figure A1: Average Daily Time Spent in Selected Locations, by Age (Weekdays Only)



Appendix B:
Description of Heat Risk-Reducing Interventions

Indoor built environment interventions to reduce ambient temperatures

Weatherization

Weatherization is "The process of reducing energy consumption and increasing comfort in buildings by improving the energy efficiency of the building and maintaining health and safety."[1] Examples of weatherization measures specific to cooling include insulation (attic, wall, floor), air sealing, window and door replacement, window shades / insulated shades, replacing air filters in air conditioning, and repairing leaks in cooling ducts.[2]

Insulation is a key component of weatherization and involves the application of building materials that inhibit the heat transfer between the inside and outside of a building.[3] Here, the choice of wall insulation is important. For example, a thermal simulation done in the UK found that internal wall insulation is less effective than external wall insulation and has a risk of overheating.[4] Air sealing is another type of weatherization measure that involves the prevention of air leaking, which results in loss of cool air from a building.[5] Air sealing practices such as weatherstripping or caulking are relatively inexpensive compared to insulation.

In a 2018 study that investigated a 2009 heat wave scenario in Melbourne, Australia, results showed that residents of energy inefficient houses are approximately 50% more vulnerable to experiencing heat stress during a heatwave compared to the residents of energy efficient houses.[6] In a 2016 report, E4TheFuture reviewed 14 existing studies that examined the occupant health or indoor environmental benefits of residential energy efficiency upgrades, in which results showed that weatherization upgrades reduced heat-related thermal stress in the form of lower medical costs and fewer deaths. Specifically, the results showed that there were 0.01 deaths, 1.1 hospitalizations, 23.6 emergency department visits, and 3.2 physician office visits avoided annually for heat-re-

[1] National Association for State Community Services Programs. (n.d.). *Technical Glossary*. https://nascsp.org/wap/waptac/wap-resources/technical-glossary/

[2] U.S. Department of Energy. (2018). *Weatherization Works!* https://www.energy.gov/sites/prod/files/2018/03/f49/WAP-fact-sheet_final.pdf

[3] U.S. Environmental Protection Agency. (2009). *A Guide to Energy-Efficient Heating and Cooling* https://www.energystar.gov/ia/partners/publications/pubdocs/HeatingCoolingGuide%20FINAL_9-4-09.pdf

[4] Porritt, S., Cropper, P., Shao, L., & Goodier, C. (2012). Ranking of interventions to reduce dwelling overheating during heat waves. *Energy and Buildings*, *55*, 16–27. doi: 10.1016/j.enbuild.2012.01.043

[5] U.S. Department of Energy. (n.d.). *Air Sealing Your Home*. https://www.energy.gov/energysaver/weatherize/air-sealing-your-home

[6] Alam, M., Rajeev, P., Sanjayan, J., Zou, P. X., & Wilson, J. (2018). Mitigation of heat stress risks through building energy efficiency upgrade: a case study of Melbourne, Australia. *Australian Journal of Civil Engineering*, *16*(1), 64-78.

lated thermal stress, per 1000 units weatherized.[7]

Cool Roofs, Green Roofs, and Green Facades

Cool roofs can reflect sunlight and absorb less heat than traditional roofs, which helps reduce temperatures in buildings. This can help reduce the need for air conditioning and reduce peak energy demands on the grid. Cool roofs can take different forms, including paint coatings, tiles, and shingles, usually dependent on the roof slope.[8] Green roofs, which are created by installing layers of soil and vegetation on rooftops, can also reduce heat absorption and cool surrounding areas through reflectance (higher albedo than standard roof materials) as well as evapotraspiration. Green facades work similarly, but are placed on other non-roof facades of the building.

A study by Vahmani et. al. (2016) that utilized a regional climate modeling framework to simulate the current and future (mid-century and end-century) climate of Southern California found that a metropolis-wide adoption of cool roofs can significantly offset present average daytime warming, reducing temperatures by 0.9 °C compared to a control model without cool roofs. Residential cool roofs were responsible for 67% of the cooling. [9] In a 2019 study, regional climate simulations for California showed that cool roofs were able to offset increased daytime heat exposure (as defined by daytime maximum temperature) but had little effect on increased nighttime heat exposures.[10] Compared to other heat mitigation measures however, researchers found cool roofs are the most effective in reducing future exposure to heat waves. [11]

A 2016 study utilized a series of micrometeorological simulations for an extreme heat day in El Monte, a neighborhood in eastern Los Angeles County, to compare cooling efficacy for various mitigation strategies, including solar reflective cool roofs, vegetative green roofs, solar reflective cool pavements, and increased street-level trees.[12] Researchers found that while street trees and cool pavements reduced air temperature at 1.5 meters (average height of the human body core), cool and green roofs mostly provided cooling at heights above pedestrian level.

Green facades can mitigate heat absorption and increase thermal comfort for occupants. In a 2020 study, researchers employed a microclimate simulation model to evaluate the summer cooling effects of block-scale facade greening and its relationship with varieties of urban form in Nanjing, China.[13] Results showed the maximum cooling intensity of green facades was 0.96 °C and observed in the high-rise high-density block urban form site. The

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[7] E4TheFuture. (2016). *Occupant Health Benefits of Residential Energy Efficiency*. https://e4thefuture.org/wp-content/uploads/2016/11/Occupant-Health-Benefits-Residential-EE.pdf

[8] U.S. Environmental Protection Agency. (2008). *Reducing Urban Heat Islands: Compendium of Strategies Cool Roofs.* https://www.epa.gov/sites/default/files/2017-05/documents/reducing_urban_heat_islands_ch_4.pdf

[9] Vahmani, P., Sun, F., Hall, A., & Ban-Weiss, G. (2016). Investigating the climate impacts of urbanization and the potential for cool roofs to counter future climate change in Southern California. *Environmental Research Letters*, *11*(12), 124027.

[10] Vahmani, P., Jones, A. D., & Patricola, C. M. (2019). Interacting implications of climate change, population dynamics, and urban heat mitigation for future exposure to heat extremes. *Environmental Research Letters*, *14*(8), 084051.

[11] Ibid.

[12] Taleghani, M., Sailor, D., & Ban-Weiss, G. A. (2016). Micrometeorological simulations to predict the impacts of heat mitigation strategies on pedestrian thermal comfort in a Los Angeles neighborhood. *Environmental Research Letters*, *11*(2), 024003.

[13] Peng, L. L., Jiang, Z., Yang, X., He, Y., Xu, T., & Chen, S. S. (2020). Cooling effects of block-scale facade greening and their relationship with urban form. *Building and Environment*, *169*, 106552.

study results suggest that cooling effects are influenced not only by the green façade's size, shape, and plant configuration but also by the spatial pattern of neighboring buildings.[14]

Solar PV

Solar energy systems have two primary benefits: offsetting the energy demand that results from increasing air conditioning use and reducing ambient temperatures within a building, similar to the cool roof effect. It is widely known that solar energy is an important means of reducing greenhouse gas emissions. As energy demand increases, especially given more frequent air conditioning use during the day, solar energy is a way to limit the use of fossil fuel-based electricity.[15] In addition to this benefit, solar photovoltaic systems provide direct cooling to buildings.[16] A study utilizing meteorological modeling for the Los Angeles region found that cooling by solar PV can reach up to 0.2°C for the average air temperature at various elevations within the urban canopy layer.[17] This is due to the higher albedo of solar panel materials relative to the material of a building roof.[18] However, the effectiveness of this benefit is dependent on the type of roof.[19] Specifically, a UC San Diego study found that the effectiveness was greater on pitched roofs than flat roofs.[20]

Access to Air Conditioning

Access to air conditioning helps reduce the risk of heat-induced illnesses and mortality by using energy to transfer heat from the inside of a building to the outside.[21] A 2021 epidemiological study found that a 10% and 20% increase in AC use would generate annual mortality reductions of 16% and 33% in the years 2025 and 2050, respectively.[22] However, air conditioning units contribute to greenhouse gas emissions if powered by electricity produced from fossil fuels. They can increase the risk of power outages during high-heat days and can also be costly to operate, which may make them prohibitively expensive for economically strained households, schools, or businesses to use on a consistent basis.

Public Cooling Centers

Cooling centers are designated air-conditioned spaces that can provide a safe resting place for users who do not have access to air conditioning or may not be able to afford air conditioning. Pub-

[14] Ibid.

[15] Salamanca, F., et al. (2018). Boundary-Layer Meteorol. Citywide Impacts of Cool Roof and Rooftop Solar Photovoltaic Deployment on Near-Surface Air Temperature and Cooling Energy Demand. https://link.springer.com/article/10.1007/s10546-016-0160-y

[16] Dominguez, A., Kleissl, J., & Luvall, J. C. (2011). Effects of solar photovoltaic panels on roof heat transfer. *Solar Energy*, *85*(9), 2244–2255. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0038092X11002131

[17] Taha, H. (2013). The potential for air-temperature impact from large-scale deployment of solar photovoltaic arrays in urban areas. *Solar Energy*, *91*, 358–367. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0038092X12003386

[18] Salamanca, F., et al. (2018). *Boundary-Layer Meteorol.* Citywide Impacts of Cool Roof and Rooftop Solar Photovoltaic Deployment on Near-Surface Air Temperature and Cooling Energy Demand. https://link.springer.com/article/10.1007/s10546-016-0160-y

[19] Taha, H. (2013). The potential for air-temperature impact from large-scale deployment of solar photovoltaic arrays in urban areas. Solar Energy, 91, 358–367. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0038092X12003386

[20] Dominguez, A., Kleissl, J., & Luvall, J. C. (2011). Effects of solar photovoltaic panels on roof heat transfer. *Solar Energy*, *85*(9), 2244–2255. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0038092X11002131

[21] DOE. Air conditioning. https://www.energy.gov/energysaver/home-cooling-systems/air-conditioning

[22] Basu, R. (2021). California and Climate Changes: An Update. In *Climate Change and Global Public Health* (pp. 237-251). Humana, Cham.

lic libraries, recreation centers, senior centers, places of worship, and other public spaces can be designated as cooling centers.[23] These centers can be permanent designations, i.e., anytime ambient temperatures exceed a threshold they are activated, or in times of higher need new centers can be designated. Potential users may experience a barrier to using/accessing cooling centers if they 1) do not have transportation options to get there; 2) if cooling centers are out of the way/out of their normal routine; 3) if centers don't have appropriate amenities (e.g., food, entertainment, pet accommodation).

Community-scale built environment interventions

Tree Planting and Urban Greening

Tree planting and urban greening can address the urban heat island effect as well as pedestrian and household comfort when placed strategically to provide shade.[24] A 2018 study that utilized a systematic review of measured and simulated study findings published from 1979 until 2017 found that a building with trees and other vegetation in North America uses 2.3 to 90% less cooling energy and 1% to 20% less heating energy than a building without them.[25] The study concludes that the placement of trees in tandem with air conditioning could help mitigate heat wave effects and building warming, while also increasing energy savings.[26]

In another 2018 study, researchers employed tree characteristics and microclimate field measurements paired with simulations of different levels of tree shading, tree transpiration, and treeless conditions to find the cooling impact of trees on buildings in Nanjing, China. Results showed that within the standard existing trees condition, building energy use decreased by 10.3% compared to a treeless condition. In addition, a scenario with more trees led to building energy use reduction by 15.2% and a scenario with trees of a greater transpiration capacity led to building energy use reduction by 12.4%.[27]

Cool Streets

Treating streets and surfaces such as parking lots with reflectant sealants can reduce surface heat absorption and reduce ambient temperatures. Cool pavement coatings are sensitive to excessive wear and tear, and thus may be best suited in certain locations such as parking lots or residential streets with limited traffic.

In a 2020 study that used field biometerological observations of cool pavements in two Los Angeles neighborhoods, researchers found that surface temperatures of coated concrete was 4 to 6 degrees Celsius lower than that of regular asphalt concrete. However, the study also found that coated concrete added more shortwave radiation to surrounding areas during parts of the day and also exhibited higher mean radiant temperature (a metric that is used to estimate human thermal comfort) during midday compared to regular concrete. The study noted that these findings "illustrate the benefits and disadvantages of reflective pavement with respect to various thermal performance metrics" and that "[c]ities should weigh the tradeoffs of UHI mitigation, thermal expo-

[23] More information on cooling centers can be found on page 17 here: https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment_508.pdf

[24] Bowler, D. E., Buyung-Ali, L., Knight, T. M., & Pullin, A. S. (2010). Urban greening to cool towns and cities: A systematic review of the empirical evidence. *Landscape and Urban Planning*, *97*(3), 147–155.

[25] Ko, Y. (2018). Trees and vegetation for residential energy conservation: A critical review for evidence-based urban greening in North America. Urban For Urban Green 34: 318–335.

[26] Ibid.

[27] Hsieh, C. M., Li, J. J., Zhang, L., & Schwegler, B. (2018). Effects of tree shading and transpiration on building cooling energy use. *Energy and Buildings*, *159*, 382-397.

sure, implementation and maintenance costs, lifecycle, and other competing priorities…" when considering the use of space for cool street interventions.

Shade Structures (Transit)

Shade structures, such as bus shelters, provide respite from direct sunlight through shade provision. These structures can provide both transit users and pedestrians refuge from heat exposure, and may also help improve transit usership during extreme weather conditions.[28] However, research is generally limited on the topic of bus shelters and transit ridership, specifically as it pertains to extreme heat.

Public Recreational Water Facilities (e.g., pools, spray parks)

Beyond designated cooling centers, there are other public facilities such as public pools or spray parks/aquatic playgrounds that can help individuals stay cool during periods of high heat. Spray parks or splash pads provide a cooling option and recreational activity for those who do not have access to air conditioning or swimming pools at home. Spray parks use less water than pools (approximately 15% to 20% of the water used by a medium-sized municipal pool)[29] and are less expensive to install. [30]

Urban Morphology / Form

Urban design strategies like considerations of building geometry, orientation, and density can be used to create shade from direct sunlight, maximize cooling effects of wind, and minimize median radiant temperatures for outdoor thermal comfort.[31]

A 2020 study applied computational simulation techniques to different residential zones in Liverpool, Australia, to test the impact of urban design on outdoor thermal comfort measured by physiological equivalent temperature (PET). The four urban design factors tested included street orientation, aspect ratio (the ratio between a building's height and the width of the street), building typology, and surface coverage (greenery). Results showed that wind velocity had the most significant effect on the thermal comfort of the outdoor spaces in Liverpool's coastal region due to the region's strong airflow. The study found that street canyon orientation was the most influential factor (46.42% of daytime) on thermal comfort (based on PET frequency and relative to heat/cold stress), followed by aspect ratio (30.59% of daytime). The researchers stressed the urban development and planning policy implications of the findings that allow stakeholders to understand and prioritize the essential urban design factors that influence the thermal comfort of outdoor spaces.[32] While these results are specific to Liverpool or regions with similar humid subtropical climatic conditions, such urban form research illustrates the efficacy of urban design factors on heat mitigation for thermal comfort and urban well-being.

[28] Mass Transit. (2016). *Shelters Help Improve Ridership During Extreme Heat and Cold.* https://www.masstransitmag.com/bus/press-release/12284922/urban-transportation-center-at-the-university-of-illinois-at-chicago-utc-shelters-help-improve-ridership-during-extreme-heat-and-cold

[29] Singh, R., Arrighi, J., Jjemba, E., Strachan, K., Spires, M., & Kadihasanoglu, A. (2019). Heatwave guide for cities. *Red Cross Red Crescent Climate Centre*, *92*.

[30] Walker, A. (2019). *Splash Pads Are the New Public Pools.* https://archive.curbed.com/2016/8/25/12613140/summer-swimming-pool-fountains-splash-pads-cities.

[31] Jamei, E., Ossen, D. R., Seyedmahmoudian, M., Sandanayake, M., Stojcevski, A., & Horan, B. (2020). Urban design parameters for heat mitigation in tropics. *Renewable and Sustainable Energy Reviews*, *134*, 110362.

[32] Abdollahzadeh, N., & Biloria, N. (2021). Outdoor thermal comfort: Analyzing the impact of urban configurations on the thermal performance of street canyons in the humid subtropical climate of Sydney. *Frontiers of Architectural Research*, *10*(2), 394-409.

Outreach interventions to reduce health impacts associated with heat

Community Alerts, Preventative Education, and Information Dissemination

Providing people with information on heat risks, ways of staying cool, and ways to avoid heat-related illnesses can help reduce heat-related health impacts. Emergency notifications as well as ongoing education on heat risks can both assist in this process.

Direct Outreach for Vulnerable, At-Risk Populations

Direct outreach for vulnerable populations during heat waves includes check-ins to ensure that individuals are not experiencing heat illnesses; to provide heat illness-prevention information (e.g., staying indoors, staying hydrated, using fans or air conditioning); and to help residents relocate if it is not possible to cool their current location to a safe temperature.

Social networks are an important aspect of ensuring individuals stay safe during periods of high heat. Programs such as New York City's *Be a Buddy* campaign have worked to strengthen social networks to support emergency management and mutual aid efforts.[33]

Interventions to reduce adverse financial impacts associated with heat

Bill Pay Assistance

The most visible threats posed by extreme heat are often health related. However, the financial strain of increased energy bills due to more time inside and increased AC usage can drain household finances. As air conditioning use increases on hotter days, household utility costs rise. This poses an outsized burden on low-income households for whom energy costs represent a higher portion of household budgets. [34] Programs designed to assist households with managing this energy burden can help ensure that safe indoor cooling practices are upheld, and that residents' health and safety are not compromised at the expense of affordable energy bills.

[33] City of New York. (n.d.)., *Extreme Heat and Your Health.* https://www1.nyc.gov/site/doh/health/emergency-preparedness/emergencies-extreme-weather-heat.page
[34] U.S. Department of Energy. (n.d.). *Low-Income Community Energy Solutions.* https://www.energy.gov/eere/slsc/low-income-community-energy-solutions

Appendix C:
Tables of Program Details

Table C1: Heat Risk-Reducing Measures Supported by State Programs

X = Explicitly listed as a measure supported by the program
(X) = Not explicitly listed as a measure supported by the program, but presumed to be based on program guidelines

For Households											
State Programs / Funding Resources	Administering Agency	Utility Financial Assistance	AC Replace-ment / Repair	Weather-ization	Urban Greening	Cool Roofs	Cool Streets	Shade Structures	Solar PV	Plans to Address Extreme Heat	Education / Outreach
Low-Income Weatherization Program (LIWP)	Community Services and Development (CSD)		X	X		X			X		
Low Income Home Energy Assistance Program (LIHEAP)	CSD	X	X	X							
Weatherization Assistance Program (WAP)	CSD			X							
Disadvantaged Communities - Single-Family Solar Homes (DAC-SASH)	Administered by GRID-Alternatives (Overseen by CPUC)								X		
Solar on Multifamily Affordable Housing (SOMAH) program	Utilities (with CPUC oversight)								X		

Energy Savings Assistance Program (ESA)	Utilities (with CPUC oversight)			X							
California Alternate Rates for Energy (CARE) / Family Electric Rate Assistance Program (FERA)	Utilities (with CPUC oversight)	X									
Medical Baseline	Utilities (with CPUC oversight)	X									
For Workplaces											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
Cal/OSHA Heat Illness Prevention Program										X	X
For Schools											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
School Facility Program Modernization Grants	Department of General Services (DGS)		X	X							
Urban Greening (UG)	California Natural Resources Agency (CNRA)				X						
Environmental, Enhancement & Mitigation Program (EEM)	CNRA				X						

For Local Governments - Outdoor Public Spaces											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
Urban and Community Forestry Program (UCF)	CAL FIRE				X						
Urban Greening (UG)	CNRA				X						
Environmental, Enhancement & Mitigation Program (EEM)	CNRA				X						
Statewide Park Development and Community Revitalization Program (SPP)	Department of Parks and Recreation				X	X		X			
Regional Park Program (RPP) Draft guidelines	Department of Parks and Recreation				X	X		X			
Rural Recreation, Tourism and Economic Enrichment Investment Program (RRT) Draft guidelines	Department of Parks and Recreation				X	X		X			
Recreational Infrastructure Revenue Enhancement Program (RIRE) Draft guidelines	Department of Parks and Recreation				(X)	(X)		(X)			
Transformative Climate Communities Program (TCC)	SGC		X	X	X	X	X	X	X	X	

For Local Governments - Transit											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
Active Transportation Program (ATP)	Caltrans							(X)		X	
Low Carbon Transit Operations Program (LCTOP)	Caltrans							(X)			
CalSTA: Transit and Intercity Rail Capital Program (TIRCP)	California State Transportation Agency (CalSTA)							(X)			
Caltrans: State Transportation Improvement Program (STIP)	Caltrans							(X)			
Transformative Climate Communities Program (TCC)	SGC		X	X	X	X	X	X	X	X	
For Local Governments - Planning Grants											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
Affordable Housing and Sustainable Communities (AHSC) Grant Program					X	X		X	X		
Caltrans Transportation Planning Grant Program - Sustainable Communities and Strategic Partnerships Grant	Caltrans				X			X		X	

Transformative Climate Communities Program (TCC)	SGC		X	X	X	X	X	X	X	X	
For Tribal Governments											
State Programs / Funding Resources	**Administering Agency**	**Utility Financial Assistance**	**AC Replacement / Repair**	**Weatherization**	**Urban Greening**	**Cool Roofs**	**Cool Streets**	**Shade Structures**	**Solar PV**	**Plans to Address Extreme Heat**	**Education / Outreach**
Tribal Government Challenge Planning Grant Program											
California Environmental Protection Agency (CalEPA) Environmental Justice (EJ) Small Grants Program	Caltrans				X			X		X	
Transformative Climate Communities Program (TCC)			X	X	X	X	X	X	X	X	
Affordable Housing and Sustainable Communities (AHSC) Grant Program					X	X		X	X		
Active Transportation Program (ATP)								X		X	
Caltrans Transportation Planning Grant Program - Sustainable Communities and Strategic Partnerships Grant					X			X		X	

Table C2: Stated Objectives of Programs That Support Heat Risk-Reducing Measures

X = Listed as a primary objective of the program
(X) = Listed as a secondary benefit or a benefit that advances a broader vision supported by the program

For Households						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
Low-Income Weatherization Program (LIWP)	X	X				
Low Income Home Energy Assistance Program (LI-HEAP)		X	X			
Weatherization Assistance Program (WAP)		X	X			
Disadvantaged Communities - Single-family Solar Homes (DAC-SASH)	X	X				
Solar on Multifamily Affordable Housing (SOMAH) program	X	X				
Energy Savings Assistance Program (ESA)		X				
California Alternate Rates for Energy (CARE) / Family Electric Rate Assistance Program (FERA)		X				
Medical Baseline		X	X			
For Workplaces						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
Cal/OSHA Heat Illness Prevention Program			X			

For Schools						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
School Facility Program Modernization Grants						Make improvements that extend the useful life of, or enhance the physical environment of, schools
Environmental, Enhancement & Mitigation Program (EEM)	X			X		
Statewide Park Development and Community Revitalization Program (SPP)					X	
For Local Governments - Outdoor Public Spaces						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
Urban and Community Forestry Program (UCF)	X	X	X	X		Improve urban forest management and create jobs and job training opportunities.
Urban Greening (UG)	X	X	X	X	X	Decrease energy consumption, reduce vehicle miles traveled, and transform the built environment into more sustainable and enjoyable places
Environmental, Enhancement & Mitigation Program (EEM)	X			X		
Statewide Park Development and Community Revitalization Program (SPP)					X	

State Programs / Funding Resources	GHG Emissions Reductions	Economic Assistance or Opportunities for Low-Income Households or Communities	Health	Environmental Benefits	Recreation Opportunities	Other
Regional Park Program (RPP) *Draft guidelines*			X		X	
Rural Recreation, Tourism and Economic Enrichment Investment Program (RRT) *Draft guidelines*		X	X		X	
Recreational Infrastructure Revenue Enhancement Program (RIRE) *Draft guidelines*					X	
Transformative Climate Communities Program (TCC)	X	X	X	X	X	
For Local Governments - Transit						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
Active Transportation Program (ATP)	X		X			» Increase the proportion of trips accomplished by biking and walking » Transit safety
Low Carbon Transit Operations Program (LCTOP)	X	(X)	(X)	(X)		
CalSTA: Transit and Intercity Rail Capital Program (TIRCP)	X	(X)	(X)	X		» Expand and improve transit service to increase ridership » Rail service integration » Transit safety
Caltrans: State Transportation Improvement Program (STIP)	X	(X)		(X)		» Expand and improve transit service to increase ridership » Rail service integration » Transit safety
Transformative Climate Communities Program (TCC)	X	X	X	X	X	

For Local Governments - Planning Grants						
State Programs / Funding Resources	**GHG Emissions Reductions**	**Economic Assistance or Opportunities for Low-Income Households or Communities**	**Health**	**Environmental Benefits**	**Recreation Opportunities**	**Other**
Caltrans Transportation Planning Grant Program -	X	X	X	X		» Sustainable communities and transit-oriented development » Corridor studies and plans » Climate adaptation plans for transportation facilities
Transformative Climate Communities Program (TCC)	X	X	X	X	X	

Table C3: Participation Eligibility Criteria of Household Programs That Support Heat Risk-Reducing Measures

For Households		
State Programs / Funding Resources	**Eligible Households**	**Eligible Regions**
Low-Income Weatherization Program (LIWP) - Multifamily component	Buildings may qualify for the program provided that 66% of the dwelling units are occupied by households with incomes at or below 80% of Area Median Income (AMI)	Statewide
LIWP Farmworker Housing	Dwellings verified to be occupied by a **low-income** farmworker or farmworker family (low-income is defined as having a household income at or below 80% of the statewide median income; or a household income at or below the threshold designated as low income by the Department of Housing and Community Development's list of 2016 State Income Limits).	Must be located in Region A or Region B **Region A**: Fresno, Madera, Merced, Monterey, San Joaquin, and Stanislaus **Region B**: Imperial, Kern, Riverside, Santa Barbara, Tulare, and Ventura
Low Income Home Energy Assistance Program (LIHEAP)	Household income at or below 60% of the state median income	Statewide
Weatherization Assistance Program (WAP)	Household income at or below 200% of federal poverty guidelines	Statewide
Disadvantaged Communities - Single-family Solar Homes (DAC-SASH)	Household income at or below 200% of federal poverty guidelines	Property is located in a **disadvantaged community** (scoring in top 25% of CalEnviroScreen 3.0 score); and within service territory of Pacific Gas & Electric (PG&E), Southern California Edison (SCE), or San Diego Gas & Electric (SDG&E)
Solar on Multifamily Affordable Housing (SOMAH) program	See right	Property is located in a **disadvantaged community** (scoring in top 25% of CalEnviroScreen 3.0 score) or 80% of property residents have incomes at or below 60% of the area median income (AMI); and property is a utility or community choice aggregator customer in the PG&E, SCE, SDG&E, PacifiCorp or Liberty Utilities territories
Energy Savings Assistance Program (ESA)	Household income at or below 200% of federal poverty guidelines	Offered to customers of California's investor-owned utilities, including PG&E; SCE; SDG&E; Southern California Gas; Alpine Natural Gas; Bear Valley Electric; Liberty Utilities; PacifiCorp; and Southwest Gas

Continues next page.

For Households		
State Programs / Funding Resources	**Eligible Households**	**Eligible Regions**
California Alternate Rates for Energy (CARE) / Family Electric Rate Assistance Program (FERA)	Household income at or below 200% of federal poverty guidelines / Household income at or below 250% of federal poverty guidelines	» CARE is offered to customers of several investor-owned utilities, including PPG&E; SCE; SDG&E; Southern California Gas; Bear Valley Electric; and Liberty Utilities) » FERA is offered to customers of California's three major investor-owned utilities, PG&E; SCE; SDG&E
Medical Baseline	Eligibility based on whether customer has special medical needs and/or are dependent on life-supporting equipment	Offered to customers of California's investor-owned utilities regulated by the California Public Utilities Commission

Table C4: Participation Eligibility Criteria and Funding Allocation Targets for Grant Programs That Support Heat Risk-Reducing Measures

X = Required for funding eligibility
(FA) = Prioritized for funding allocation

For Local Governments - Outdoor Public Spaces						
State Programs / Funding Resources	**DACs**	**Low-Income**	**Park Space**	**Urban or Rural**	**Details on Eligibility**	**Details on Funding Allocation Prioritization**
Urban and Community Forestry Program (UCF)	(FA)	(FA)		U	The project area must be in an urban area or immediately adjacent to an urban area.	For 2019/2020, 80% of the appropriation for this grant program will be expended on projects located within AB 1550 disadvantaged communities.
Urban Greening (UG)	(FA)	(FA)		U	Projects must be located in urban areas	The program intends to award funding as follows: » 60% to projects within and benefiting disadvantaged communities (top 25% in CalEnviroScreen 3.0); » 10% to projects within and benefiting AB 1550 low-income communities (at or below 80% of the statewide median income); » 5% to projects within and benefiting AB 1550 low-income communities that are within a half mile of a disadvantaged community.
Environmental Enhancement & Mitigation Program (EEM)					Statewide	
Statewide Park Development and Community Revitalization Program (SPP)	(FA)	X (FA)	X		Must meet one of the following conditions » Has a ratio of less than 3 acres of park space per 1,000 residents or » Has a median household income less than $51,026, (80% of the statewide average)	Per Proposition 68 (2018 Bond Act) §80008(a)(1), at least 20% ($130,055,000) of the $650,275,000 must be allocated to projects in severely disadvantaged communities that have a median household income below $38,270 (60% of the statewide average).
Regional Park Program (RPP) *Draft guidelines*		(FA)			Statewide	Per Proposition 68 (2018 Bond Act) §80008(a)(1), at least 20% ($4,625,000) of the $23,125,000 must be awarded to severely disadvantaged communities with a median household income below $38,270 (60% of the statewide average).

Rural Recreation, Tourism and Economic Enrichment Investment Program (RRT) *Draft guidelines*		(FA)			Statewide	Per Proposition 68 (2018 Bond Act) §80008(a)(1), at least 20% ($4,625,000) of the $23,125,000 must be awarded to severely disadvantaged communities with a median household income below $38,270 (60% of the statewide average).
Recreational Infrastructure Revenue Enhancement Program (RIRE) *Draft guidelines*					Local jurisdictions with agencies that have obtained voter approval from November 1, 2012, through November 30, 2018, inclusive, for revenue- enhancement measures aimed at improving and enhancing local or regional park infrastructure.	
Transformative Climate Communities Program (TCC)	X	X			» Implementation Grants: Communities in which more than half of the area overlaps with census tracts in the top 10% of the CES rankings, and the remaining 49% of the project area overlaps with census tracts in the top 25% of CES rankings, or with AB 1550 low-income tracts, and » Planning Grants: Communities in which all census tracts fall within the top 25% of the CES rankings.	
For Local Governments - Transit						
State Programs / Funding Resources	**DACs**	**Low-Income**	**Park Space**	**Urban or Rural**	**Details on Eligibility**	**Details on Funding Allocation Prioritization**
Active Transportation Program (ATP)	(FA)			(FA)	Statewide	» 40% of funds must go to Metropolitan Planning Organizations in urban areas with populations greater than 200,000; a minimum of 25% of these funds must benefit DACs. » 10% of funds must go to small urban and rural areas with populations of 200,000 or less; a minimum of 25% of these funds must benefit DACs. » 50% of projects will be awarded on a competitive basis statewide; a minimum of 25% of these funds must benefit DACs.

Low Carbon Transit Operations Program (LCTOP)	(FA)				Statewide	Transit agencies receiving funding under LCTOP whose service areas include a DAC must expend at least 50% of the total funds received on projects within DACs.
CalSTA: Transit and Intercity Rail Capital Program (TIRCP)	(FA)				Statewide	A minimum of 25% of program funds must benefit DACs.
Caltrans: State Transportation Improvement Program (STIP)	X (FA)	X (FA)			Statewide	Per AB 1550, » a minimum of 25% must go to projects within, and benefiting individuals living in, disadvantaged communities » an additional minimum of 5% to projects that benefit low-income households or to projects within, and benefiting individuals living in, low-income communities anywhere in the state » an additional minimum of 5% either to projects that benefit low-income households that are outside, but within a 1/2 mile of, disadvantaged communities, or to projects within the boundaries of, and benefiting individuals living in, low-income communities that are outside, but within a 1/2 mile of, disadvantaged communities
Transformative Climate Communities Program (TCC)	X	X			» Implementation Grants: Communities in which more than half of the area overlaps with census tracts in the top 10% of the CES rankings, and the remaining 49% of the project area overlaps with census tracts in the top 25% of CES rankings, or with AB 1550 low-income tracts, and » Planning Grants: Communities in which all census tracts fall within the top 25% of the CES rankings.	

For Local Governments - Planning Grants						
State Programs / Funding Resources	**DACs**	**Low-Income**	**Park Space**	**Urban or Rural**	**Details on Eligibility**	**Details on Funding Allocation Prioritization**
Caltrans Transportation Planning Grant Program - Sustainable Communities Grant / Strategic Partnerships Grant	X	X			Statewide	No explicit priorities listed.
Transformative Climate Communities Program (TCC)	X	X			» Implementation Grants: Communities in which more than half of the area overlaps with census tracts in the top 10% of the CES rankings, and the remaining 49% of the project area overlaps with census tracts in the top 25% of CES rankings, or with AB 1550 low-income tracts, and » Planning Grants: Communities in which all census tracts fall within the top 25% of the CES rankings.	

For Workplaces	
State Programs / Funding Resources	**Eligible Regions**
Cal/OSHA Heat Illness Prevention Program	Statewide

For Schools	
State Programs / Funding Resources	**Eligible Regions**
School Facility Program Modernization Grants	Statewide
Urban Greening (UG)	Projects must be located in urban areas
Environmental, Enhancement & Mitigation Program (EEM)	Statewide

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