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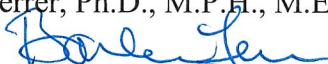
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July 14, 2025

TO: Each Supervisor

FROM: Barbara Ferrer, Ph.D., M.P.H., M.Ed.
Director 

**SUBJECT: ESTABLISHING A SAFE MAXIMUM TEMPERATURE THRESHOLD
FOR RESIDENTIAL UNITS (ITEM NO. 4, AGENDA OF JANUARY 23,
2024, DIRECTIVE 1)**

This is in response to the January 23, 2024 motion by your Board directing the Department of Public Health (Public Health), in collaboration with the Chief Sustainability Office (CSO), the Executive Director of the Los Angeles County Development Authority (LACDA), and the Department of Consumer and Business Affairs (DCBA), to conduct stakeholder engagement, including to renters, landlords, public health professionals, and other relevant community-based organizations and groups regarding establishing a maximum indoor temperature for rental dwellings in the County of Los Angeles and report to the Board within 150 days with recommendations for how to equitably establish, define, implement, and enforce relevant policy for rental units.

Public Health established an interagency workgroup, gathered and reviewed information from other jurisdictions and research reports, and engaged a contractor to conduct stakeholder engagement to inform development of the ordinance. Once the ordinance was drafted, Public Health held six stakeholder meetings to present the draft ordinance publicly and take comments from stakeholders. These efforts are described below.

INTERDEPARTMENTAL WORKGROUP

Public Health established a workgroup consisting of representatives from the CSO, County Counsel, LACDA, the Departments of Regional Planning (DRP), Public Works (DPW), Consumer and Business Affairs (DCBA) and Economic Opportunity (DEO). The workgroup met six times between June and November 2024. Discussions focused on building and safety code; how changing codes in one Title of County Code can impact another; existing enforcement practices among various departments; tenant protections; and resources to assist landlords in complying with new requirements. Conversations from these meetings clarified that 1) a new ordinance would need to ensure that adding portable cooling units¹ will not conflict with building code, for example related to fire egress/access for fire response activities; 2) tenant protections in County Code Chapter 8.52, Rent Stabilization and Tenant Protections Ordinance² (RSTPO) would apply for rental properties in unincorporated LA County; and 3) coordination between departments would be needed during the implementation phase. The issues the motion seeks to address are complex in terms of the crossover between local and state jurisdictions and across agencies and areas of expertise (building codes, energy regulations, health code, etc.), and the workgroup was critical in providing access to various areas of expertise and perspectives from those fields.

INFORMATION GATHERING

Jurisdictional Review

Public Health conducted a review to identify other jurisdictions across the United States with existing indoor maximum temperature requirements, reviewed existing code language for 14 jurisdictions, and reached out to these jurisdictions with questions regarding implementation and enforcement of the codes (see Attachment A for more details). General findings include:

- Most surveyed jurisdictions require air conditioning or mechanical cooling, although two require units to be capable of maintaining a temperature below a certain threshold using active or passive cooling methods.
- The jurisdictions are smaller than LA County, their housing stock includes significantly higher numbers of new construction, and the large majority of these existing units already have air conditioning installed.
- Of the jurisdictions Public Health was able to interview, all advised that their maximum temperature standard does not apply retroactively but only to rental units built after the requirement went into effect. It is likely that other jurisdictions with maximum temperature regulations that are part of residential, property, or building code similarly do not apply retroactively.
- No other jurisdiction has established a maximum temperature for residential units through Health and Safety code. Generally, these jurisdictions have established these ordinances through Building Code

¹ “Portable cooling device” means a mechanical device used to cool a room that can be temporarily affixed, mounted, or secured for use and easily removed without permanent attachment to the structure, including portable air conditioners, evaporative coolers, and window-mounted air conditioning units.

² HOA.104974507.1

- Temperature thresholds range from 70 degrees to 90 degrees Fahrenheit. Three Arizona jurisdictions have separate temperature thresholds specific to the type of cooling (e.g., air conditioning or evaporative cooling, swamp cooler). One jurisdiction sets the maximum temperature threshold at 70 degrees, six at 80 degrees, three at 82 (all with a higher maximum for evaporative cooling), two at 85, one at 90, and one sets no maximum.

A variety of the jurisdictions, in different climate zones across the country, have set indoor maximum temperature thresholds for rental housing that reflect the different climate zones in which they were adopted. Applying a heat standard to existing buildings that may not already have air conditioning or evaporative cooling is a unique approach and does not appear to have been implemented elsewhere. Additionally, establishing this type of regulation through the Health and Safety code and enforcing these public health protections through an Environmental Health Division are not the standard approach taken by other jurisdictions, where enforcement typically consists of ensuring cooling equipment is functioning properly.

AB 209 Report

California State Assembly Bill [AB 209](#), passed in 2022, required the California Department of Housing and Community Development (HCD) to consult with stakeholders and develop policy recommendations for establishing a maximum safe indoor air temperature threshold statewide. In June 2024, HCD released a draft report for public comment, and final policy recommendations were released in February 2025 (Attachment B). The HCD report recommended that the State consider a maximum safe indoor air temperature of 82 degrees Fahrenheit, with different approaches put forward for new and existing buildings.

For newly constructed residential dwelling units, the report recommended implementation through building standards and statewide policy, given that newly constructed dwelling units must meet higher standards than older buildings for energy efficiency and are typically equipped with some sort of mechanical cooling. The report recommended incentivizing retrofits such as cool roofs, cool walls, window shading, building shading, whole house ventilation, fans, landscaping, and evaporative cooling in the appropriate climate zones for existing buildings. The report did not include a recommendation that existing buildings be required to meet the 82 degrees Fahrenheit maximum temperature threshold.

The report also included equity-focused recommendations, including ensuring that high-risk populations have the right to add cooling, and identifying/implementing measures to financially support tenants' ability to afford to operate cooling equipment and landlords' ability to make energy and weatherization upgrades to low-income housing.

Also of note, County-supported Senate Bill 655 which is proceeding in the State Assembly, would declare the policy of the state that all residential dwellings are required to be able to attain and maintain a safe maximum indoor temperature. The bill would also require state agencies to consider that state policy when revising or establishing policies, programs, and rules relevant to achieving that state policy goal.

STAKEHOLDER ENGAGEMENT

In April 2024, Public Health contracted with Estolano Advisors to carry out stakeholder engagement, under Public Health's direction, regarding a maximum indoor temperature threshold ordinance for the County of Los Angeles, excluding the cities of Pasadena, Long Beach, and Vernon, which operate their own public health departments. A full copy of the Estolano report is included in Attachment C.

During summer 2024, ten interviews and six workgroup meetings were held with a broad range of stakeholders to collect feedback and recommendations on how to make the policy successful.

Guiding Questions

The stakeholder engagement approach aimed to address several key areas of inquiry, which are based on the directives in the 2024 Board Motion:

- Enforcement Considerations: How can the County monitor and ensure compliance? What will enforcement look like?
- Landlord Incentives and Support: What implementation guidance or supports (technical and financial) would enable large landlords (100+units) to comply within one year and what would enable medium and small landlords to comply within three years and five years, respectively?
- Tenant Protections: How can the County identify, prevent, mitigate, or address unintended consequences for tenants?
- Weatherization/Passive Cooling: What can the County do to minimize potential increases in energy use associated with air conditioning, such as by encouraging or facilitating the adoption of passive cooling strategies?
- Temperature Threshold: What are the potential health and quality of life impacts of a maximum indoor temperature threshold of 82 degrees Fahrenheit? What is the feasibility of this temperature threshold for the existing building stock?

Engagement Process

The engagement process was designed to reach a broad range of stakeholders, which included: building and energy technical experts; landlords and real estate professionals; legal services providers; tenants' rights groups and community-based organizations (CBOs); tenants; and local jurisdictions with similar policies. An overview of each engagement phase is below.

The first phase took the form of a series of one-on-one, virtual meetings with participants. Questions were customized to each stakeholder group. The preliminary findings from these interviews informed the Phase II workgroup approach.

Phase II consisted of six virtual workgroup meetings that expanded on the topics raised during Phase I and involved a broader audience. Each workgroup meeting was limited to 30 attendees to ensure that everyone had a chance to participate. Similar to the Phase I interviews, Phase II meetings followed a custom set of interview questions for each stakeholder type.

STAKEHOLDER RECOMMENDATIONS

The stakeholder meetings resulted in a series of recommendations (underlined) that addressed policy considerations; tenant and landlord resources, support, and concerns; climate resilience and infrastructure; and collaboration with other policy efforts. Details regarding how Public Health and other County Departments addressed the recommendations in the development of the draft ordinance are included after each recommendation. Attachment C contains the complete Estolano Advisors report.

1. Policy Considerations

a) Temperature Threshold Considerations

- i. LA County should follow recent research to inform a temperature threshold that is based on robust data and is easily justifiable to stakeholders. The Board motion request to set one threshold resulted in the recommendation by Public Health to establish an indoor maximum temperature threshold of 82 degrees Fahrenheit.
- ii. LA County should conduct a study that evaluates the cost and energy impacts of the policy to determine funding needs. In response to a March 15, 2022 [Board motion](#) entitled “Ensuring the Equitable Decarbonization of Buildings,” the CSO produced a [report](#) providing an overview of the impacts that building decarbonization will have on the electrical grid. Planning is currently under way to get the grid ready for the transition to 100% carbon free energy by 2045, a more ambitious and longer-term goal than improving equity in access to residential cooling. The report notes that peak energy demand in Southern California typically occurs in the hot summer months and most cooling is electric already. The report states it is not expected that building electrification would significantly increase this load, and points to heat pumps, which provide both heating and cooling, as an option to improve energy efficiency. The report concludes that the “grid already has capacity to support a significant amount of electrification.” Public Health also looked to a 2025 RAND Corporation [study](#) assessing the energy demand and climate impacts from different cooling strategies in single family homes, which provided some relevant findings used to inform ordinance development. The study concluded that increased residential cooling is likely to lead to increased energy usage. The report affirmed the importance of the current approach to promote passive cooling measures and a phase-in period to spread energy use impacts over time.

b) Tenant Protections

- i. LA County should reference existing jurisdictions’ policies to determine how to address unintended consequences for tenants. The LA County Rent Stabilization and Tenant Protections Ordinance (RSTPO) includes tenant protections related to indoor heat.

c) Phased Implementation Timeline

- i. LA County should consider a phased implementation timeline for implementing this policy that prioritizes the most vulnerable areas and provides support for early adopters. Based on the stakeholder discussions, it was determined implementation of the ordinance will be phased in with full compliance not enforced until January 1, 2027, or later, depending on when the associated fee is approved.

d) Enforcement

- i. LA County should integrate this policy's enforcement into an existing County program, such as the new Rental Housing Habitability Program. The proposed Ordinance requirements will be enforced through Public Health's Rental Housing Habitability Program (RHHP) in the unincorporated areas of the County and would be enforced by RHHP through adoption of Title 11 by incorporated cities that choose to adopt the updated ordinance.
- ii. LA County should establish a transparent and accessible reporting system for residents to report landlord non-compliance. Public Health has an online system that can be accessed at any time to report any habitability concerns and a dedicated phone number to report complaints during regular business hours. Additionally, routine inspection reports are available via Public Health's website (<http://publichealth.lacounty.gov/eh/business/housing.htm>).

e) Considerations for Mobile Homes

- i. LA County should conduct a review of mobile home regulations to determine whether this policy could support renters in mobile homes. Mobile homes are regulated by the California Department of Housing and Community Development and thus would not be included in the proposed Ordinance.

2. Resources and Support

a) General Support

- i. LA County should provide a central location with information on the policy and supportive resources, such as rebates and subsidies, for landlords and tenants. The Chief Executive Office (CEO), CSO, and Internal Services Department (ISD) developed a resource list identifying potential state and federal funding streams and other resources that could be used to support implementation of the Ordinance. [This report](#) was submitted to the Board of Supervisors on June 4, 2024, and is available an attachment to the Statement of Proceedings for the January 3, 2024, Board meeting, under the discussion of the Board motion, Agenda Item #4.

b) Support for Landlords

- i. LA County should contract with experienced TA providers to support landlords with complying with the policy and applying for funding and rebates. ISD has developed a website (CoolHealthyHomes.org) with comprehensive information on related resources for both tenants and landlords. Clean Power Alliance (CPA) has a [rebate program](#) for savings on air conditioning units and offers free [technical assistance](#) and support on energy upgrade assessments and accessing other available rebates. CSO is coordinating with CPA on the development of further technical assistance for landlords and building owners to adopt efficient cooling.

c) Support for Tenants

- i. LA County should contract with CBOs to educate tenants about the policy and provide technical support. The County is continuing to work to identify funds to work with local CBOs to support outreach and education for tenants.
- ii. Tenants expressed concern about the costs of relocating temporarily while their buildings undergo major retrofits and that such retrofits could lead to evictions by landlords. If substantial renovation is required, Chapter 8.52's guidelines regarding temporary relocation assistance would apply, and DCBA would provide guidance on the policy, once the Ordinance has been enacted. Although it may be possible that substantial renovation is required, Chapter 8.52 does not allow landlords to evict tenants due to major renovations.

3. Climate Resilience and Infrastructure

- i. County Departments should collaborate in pursuing relevant initiatives to promote community-wide cooling strategies in tandem with the policy. Public Health works closely with CSO and participates in multiple committees and different efforts related to climate change and resilience, such as the County's Community Forest Management Plan to plant trees in the unincorporated areas facing urban heat island effect. Public Health will continue to leverage opportunities that will aid in community-wide cooling and support the Safe Maximum Indoor Temperature Threshold Ordinance.

4. Collaboration with Other Policy Efforts

- i. LA County should collaborate with the City of Los Angeles and California Department of Housing and Community Development to align the maximum indoor temperature threshold with local and state decarbonization and temperature threshold policies. Public Health will continue to collaborate and work with the City of Los Angeles and the State to align policy efforts including AB 209; however, at this time neither the City of Los Angeles nor the State has established a maximum indoor temperature threshold.

Other comments from stakeholders highlighted the need for comprehensive implementation planning and assistance for landlords and tenants.

1. Landlords opposed prohibiting them from passing through costs to tenants for improvements and emphasized that upgrades to comply with the policy would be financially infeasible without an associated increase in renter payments. The proposed Ordinance will prohibit the pass-through of costs to tenants for installation of portable cooling units; however, passing through costs associated with capital improvements to come into compliance with the Ordinance may be permissible for fully covered properties subject to the Rent Stabilization Protection Ordinance (County Code 8.52.070), if approved by DCBA as a capital improvement cost, consistent with current policy and practice. Internal Services Division and CSO are working together to identify and leverage technical and financial resources to assist landlords in complying with the Ordinance and reducing pass-through costs for tenants, such as [ISD's Equitable Building Decarbonization](#) grant program which may provide financial support to upgrade electrical panels and install HVAC systems.
2. The County's older building stock will likely require substantial retrofits to adopt this policy and should have more time to do so. The proposed Ordinance would support a phased approach to ensuring indoor temperature thresholds are met, including the opportunity to implement passive cooling strategies and an ability to request an extension of time to come into compliance if active cooling is required.

DEVELOPMENT OF MAXIMUM TEMPERATURE ORDINANCE

Public Health conducted six additional virtual stakeholder and community engagement meetings in late 2024 and early 2025 to obtain feedback on a draft ordinance. These virtual meetings were held at various times of day and week, two each in November and December 2024 and February 2025, with live translation into Spanish, Mandarin, and Cantonese. In total, about 118 people attended the meetings, 40 in the tenant and 78 in the landlord meetings, representing individual landlords and tenants, apartment and landlord associations, and tenant advocacy and community groups.

In early January, after four stakeholder meetings had been completed, Los Angeles County was severely impacted by multiple wildfires, including the Palisades and Eaton Fires. The February stakeholder meetings underscored the complexities involved in moving this proposed Ordinance forward given that these recent events have made its implementation more difficult. Stakeholders expressed concerns regarding the practicality and efficacy of implementation, economic ramifications, and possible unintended negative consequences on the residential rental market. Stakeholders also emphasized that building materials and construction costs are expected to rise along with increased demand for supplies and building contractors. Comments received in the February 2025 meetings reflect the additional and significant challenges these events pose for an Ordinance that may require property owners to retrofit older buildings for compliance.

Below are themes from the comments made during virtual meetings to review the draft Ordinance language. The final version of the Ordinance language represents the effort to find

middle ground between competing and valid concerns, while doing our utmost to protect health. See Attachment D for the complete Stakeholder Ordinance Feedback Report.

- Enforcement: Both tenants and landlords expressed concerns about enforcement of the Ordinance. Tenants noted that complaint-based enforcement often fails to protect tenants and places too much of the burden of enforcement on the tenant. Landlords expressed concerns about lack of clarity regarding tenant responsibilities for keeping the unit cool.
- Temperature threshold: Landlords and tenants had differing opinions as to where the temperature threshold should be set, with landlords seeking a higher maximum temperature and tenants seeking a lower threshold. Landlords also proposed that some areas of the County be exempted from a maximum temperature Ordinance due to cooler climates.
- Installation of air conditioning: Tenants advocated the Ordinance require the installation of air conditioning. Landlords expressed concerns over the impact of requiring air conditioning to the electric grid as well as other environmental impacts.
- Costs: Both tenants and landlords were concerned about additional costs to tenants due to compliance. Additionally, landlords noted potential increased costs associated with operating rental units and possible displacement of tenants.

LA County Building Stock and Rental Housing

In developing the proposed Ordinance, a review was conducted of LA County Assessor data from 2023 to present to analyze residential buildings in unincorporated LA County based on building type and age in response to Directive 1 from the January 2024 Board motion to better understand the scale of potential financial impacts on landlords. However, the data limitations, particularly the inability to disaggregate rental housing only and the inability to predict costs associated with electrical panel upgrades, made it impossible to develop an actual estimate. Despite these limitations, there were several important findings.

Approximately ten percent (9.6%) of residential buildings in unincorporated Los Angeles County are multi-family residential buildings, and 90% of those contain two to four units. A substantial portion of residential buildings in unincorporated LA County (61%) were built prior to 1960. Census tracts in Supervisorial Districts 1 and 2 tend to have an older median building age than those in other districts.

A large percentage of multifamily residential buildings (71%) were built before 1960, with almost two in five (39%) built before 1940. Unfortunately, it is not possible to know from County Assessor data how many of these buildings already have cooling equipment or will need retrofits to accommodate electrical and weatherization to maintain the required maximum temperature threshold. Based on input from building and technical experts, it is likely that older buildings will need more extensive retrofits, which may also uncover a need for lead or asbestos remediation, thus requiring more time and resources for implementation.

According to the [UCLA 2024 Quality of Life Index Final Report](#), 75% of County residents have air conditioning in their homes, but these numbers vary by Supervisorial District with the highest percentages in the Fifth, Third, and Fourth Districts (87%, 86%, and 77%, respectively) and lower percentages in the First and Second Districts (67% and 62%, respectively). Some of this variation is due to regional climate differences, but inequities by income and race/ethnicity play a significant role in access to air conditioning as well, with residents who are Black or Latino, as well as those with lower income, having less access than others.

The RHHP applies to all rental housing properties with two or more rental housing units, tenant-occupied single-family homes, and all rental housing properties registered in the County's Rent Registry. Based on October 2024 property ownership information from the County Assessor's Office, Public Health identified an estimated total of 19,455 properties with a total of 68,636 units in the unincorporated areas of the County.

During its first half of 2025 inspection activities, RHHP identified close to 10,000 additional multiple family rental units. Table 1, below, provides the current estimate of inventory of rental units broken down by number of units and by Supervisorial District. RHHP anticipates a continued growth in inventory throughout the first four years of implementation, as RHHP continues to confirm the actual stock of rental housing in the unincorporated portions of the County.

Table 1. Estimated Number of Rental Units, By Type of Dwelling, In Unincorporated Los Angeles County, By Supervisorial District

Type	Source of Data	Estimated # Units	SD 1	SD 2	SD 3	SD 4	SD 5
Single Family Dwelling	Rent Registry	9,621	3,356	2,940	44	759	2,522
Multiple Family Dwelling, 2-4 Units	Rent Registry	45,210	18,331	18,292	118	3,325	5,144
Multiple Family Dwelling, 5+ Units	Rent Registry	42,293	12,625	14,566	86	4,618	10,398
<i>Total</i>		<i>97,124</i>	<i>34,312</i>	<i>35,798</i>	<i>248</i>	<i>8,702</i>	<i>18,064</i>

PROPOSED ORDINANCE

Public Health worked with County Counsel and the other County departments to develop a proposed Ordinance for consideration by the Board, incorporating formative stakeholder input in its initial development, and updating it to address comments received in reaction to the first draft of the Ordinance. Consistent with your Board's direction to center health concerns by utilizing Health and Safety Code, Public Health recommends amending Title 11 as follows.

- Establish 82 degrees Fahrenheit as the maximum indoor temperature threshold in covered residential units. A threshold of 82 degrees falls within the temperature range other

jurisdictions have adopted and matches the HCD recommendation for new building construction.

- The landlord of covered units should have the responsibility to ensure all units can maintain a temperature no higher than 82 degrees. The proposed Ordinance would not require landlords to add air conditioning. Units that are able to maintain temperatures no higher than 82 degrees without active cooling equipment would be in compliance. During implementation, emphasis would be placed on improving the heat resilience of existing building stock through weatherization and passive cooling strategies.
- Pass-through of costs to tenants for installing portable cooling units would be specifically prohibited. However, passing through the costs associated with capital improvements necessary to come into compliance may be permissible for fully covered rental units, subject to the RSTPO, if approved by DCBA as a capital improvement (County Code 8.52.070.), consistent with current policy and practice.
- Tenants would be allowed to add additional cooling through portable cooling devices or non-mechanical cooling methods provided that it is done in a manner that does not conflict with existing building codes, state, local, or federal law, the manufacturer's written safety guidelines and recommendations for use of the portable cooling device, or require the tenant to alter or modify the rental housing unit through construction. Tenants would be required to provide five calendar days' written advance notice to the landlord of their intent to install a portable cooling device or other non-mechanical method.
- Retaliation or harassment of a tenant who installs their own cooling method would be specifically prohibited.

The proposed Ordinance would apply to rental units in unincorporated LA County subject to RHHP. Incorporated cities may also choose to adopt the Ordinance for LA County enforcement. The proposed Ordinance would not apply to units not regulated by Public Health, including mobile homes and/or LACDA housing.

The tenant protection provisions connected with the installation of portable cooling devices or other non-mechanical cooling methods will go into effect thirty (30) days from the date of final passage by the Board of Supervisors, but enforcement of the maximum indoor temperature will commence on January 1, 2027, or upon approval of the fees associated with the cost for this Chapter, whichever is later.

Enforcement

The proposed Ordinance requirements would be enforced through the RHHP for the unincorporated areas of the County and would be enforced through the existing housing inspection program in incorporated cities that choose to adopt the Ordinance. Enforcement would be carried out on a complaint basis. As temperatures can vary over the course of a day and throughout the year, enforcement through routine inspection may not identify potential violations when outdoor temperatures are cooler.

The proposed Ordinance would be implemented via a phased approach to ensure indoor temperature thresholds are met. Landlords would be provided educational material, opportunity to implement passive cooling methods, and the ability to request an extension of up to two years to come into compliance if active cooling is required. The Ordinance would not require that all buildings be retrofitted, nor would air conditioning be mandated if the temperature threshold can be maintained through other cooling methods.

Implementation

Prior to the enforcement effective date, education and technical assistance for tenants and landlords will be critical to ensure the success of the Ordinance in keeping rental units below the maximum temperature threshold. Through their Southern California Regional Energy Network (SoCalREN) program, ISD has developed a comprehensive website for tenants and landlords to provide these resources, the purpose of which is to:

- Raise awareness and understanding of the new Ordinance
- Educate tenants and landlords on passive cooling strategies
- Link to Public Health resources, financial assistance, and technical resources for tenants and landlords

The RHHP will begin preparing for implementation upon final approval of the Ordinance, which will allow the program to be ready to begin receiving complaints as of January 1, 2027. Upon approval of the Ordinance, RHHP inspectors would begin providing educational information to tenants and landlords and promoting the SoCalREN web resources as inspections are done so landlords and tenants are aware of the new Ordinance and how to prepare. Internal preparation for receiving complaints include:

- Developing program procedures, e.g., defining emergency and non-emergency violation; enforcement steps, verification of violation, etc.
- Updating data entry systems
- Developing necessary templates and forms (e.g., first notice letter, request for extension, etc.)
- Developing and finalizing additions to inspection guide for RHHP inspectors
- Hiring, onboarding, and training inspectors on new program
- Developing ordinance webpage and communications plan for RHHP website
- Training call center staff and developing communication to EH Team
- Establishing feedback and review mechanisms

Finally, DCBA will update its website and disseminate information through its existing communication channels and relevant programs and partnerships.

Fiscal Impact / Financing

The Safe Maximum Indoor Temperature Threshold Ordinance would be enforced through the RHHP. Enforcement costs would be covered by an increase in the RHHP fees in Title 8, with the enforcement effective date of January 1, 2027, or upon fee approval, whichever is later, to account for the time lag in receipt of funds to undertake the work. The increase in fees will be

requested as part of a future fee package associated with RHHP. The new work pursuant to this ordinance is anticipated to require an additional \$7.77 fee increase per covered unit.

Upon the enforcement effective date, RHHP Inspectors would respond to tenant complaints and work with landlords to correct potential violations and/or take enforcement action. Fees for enforcement of Multiple Facility Dwellings in incorporated cities that adopt the ordinance would also be included in a future fee package based upon anticipated increased additional workload.

Upgrades for LACDA Housing Properties

LACDA provides housing to thousands of County residents through its portfolio of housing properties in County unincorporated territory and incorporated cities where the ordinance, if adopted by your Board and respective city governments, would apply. While the Ordinance would not apply to LACDA due to its status as a public entity, LACDA will endeavor to ensure its resident population receive the same benefits and protections the Ordinance requires. However, LACDA's existing state and federal funding sources do not permit expenditures towards improvements, such as air conditioning fixtures and electrical infrastructure upgrades, and associated ongoing maintenance costs, that are necessary to meet the ordinance's 82-degree maximum temperature threshold. LACDA therefore intends to request that your Board consider providing funding assistance to LACDA to meet this important need for its residents.

Next Steps

The proposed Safe Maximum Indoor Temperature Threshold Ordinance is scheduled for consideration by your Board on August 5, 2025. If adopted, the ordinance would go into effect 30 days after final approval, with an enforcement effective date of January 1, 2027, or upon approval of the associated fee, whichever is later. Public Health is working with ISD to prepare educational resources and technical assistance for tenants and landlords to encourage the use of passive cooling strategies as the 2025 heat season begins and to promote early adoption by landlords of improved cooling strategies.

Please contact me if you have any questions or would like additional information.

BF:cdr

c: Chief Executive Officer
County Counsel
Executive Office, Board of Supervisors
Consumer and Business Affairs
Public Works
Economic Opportunity
Regional Planning
Chief Sustainability Office

Attachments

Maximum Indoor Temperature Threshold Review by Location

Locality	Temperature Threshold (Max)	Notes
Lancaster, CA	80°F (26.7°C)	The City of Lancaster has adopted the International Property Maintenance Code and amended it to include a requirement for air conditioning in all habitable rooms, ensuring that the temperature does not exceed a maximum of 80 degrees Fahrenheit.
Palm Springs, CA	80°F (26.7°C)	Palm Springs has adopted the International Residential Code and Property Maintenance Code. These codes have been amended to include a requirement for air conditioning systems in all habitable rooms, ensuring that a maximum temperature does not exceed 80 degrees Fahrenheit at any time.
Maricopa City, AZ	80°F (26.7°C)	Maricopa City, Arizona, has adopted and amended the International Residential Code to include requirements for heating and cooling systems. All habitable rooms, bathrooms, and toilet rooms must maintain a maximum temperature of no more than 80°F.
Phoenix, AZ	86°F (30°C)/82°F (27.8°C)	86°F for Evaporative Cooling, or 82°F if cooled by air conditioning. For over two decades, the City of Phoenix has mandated cooling standards in its neighborhood Preservation Ordinance. The ordinance requires rental units to have permanently installed cooling systems that maintain temperatures at or below 86°F for Evaporative Cooling, or 82°F if cooled by air conditioning in all habitable rooms, bathrooms, and flushing toilet rooms.
Tempe, AZ	88°F (31.1°C)/82°F (27.8°C)	88°F for Evaporative Cooling, or 82°F if cooled by air conditioning. Tempe, Arizona, mandates in Rental Housing Code that rental housing units have tenant-controlled cooling systems. These systems must maintain temperatures at or below 88°F with evaporative cooling or 82°F with air conditioning in all habitable rooms, bathrooms, and flush toilet rooms.
Tucson, AZ	86°F (30°C)/82°F (27.8°C)	86°F for Evaporative Cooling, or 82°F if cooled by air conditioning. Tucson, Arizona, has a Neighborhood Preservation Ordinance requiring all rental units to have cooling systems. Habitable rooms must maintain temperatures at or below 86°F with evaporative cooling or 82°F with air conditioning. The ordinance specifies that mechanical fans and portable evaporative cooling devices can only be used temporarily when permanent systems are being repaired or replaced.
New Orleans, LA	80°F (26.7°C)	Healthy Homes Program. New Orleans, LA has implemented a Healthy Homes program, a rental registry program with a phased approach based on property size. Under the program's minimum rental standards, each rental housing unit must have a cooling system in good working order that can maintain a maximum temperature of 80°F in all bedrooms.
Montgomery County, MD	80°F (26.7°C)	Between June 1 and September 30, does not include detached SFH. Montgomery, MD Housing and Building Standards require rental housing units to have an air conditioning system capable of maintaining a temperature of no more than 80°F in each habitable space.
Clark County, NV	85°F (29.4°C)	Clark County, Nevada, has established interior temperature standards in Building and Construction Code for dwelling units with permits issued after February 3, 2019. These

10/11/2024

Locality	Temperature Threshold (Max)	Notes
		standards require that units be designed to maintain an interior temperature between 68°F and 85°F using active or passive heating and cooling systems.
North Las Vegas, NV	70°F (21.1°C)	North Las Vegas has included specific requirements in its Uniform Housing Code since 1995. Dwelling units, guest rooms, and congregate residences must have heating and air conditioning systems capable of maintaining a room temperature of 70°F.
Oregon State	No Set Temperature	In 2022, Oregon passed Senate Bill 1536, amending the Oregon Landlord-Tenant Act to include Section 90.355. This section prohibits landlords from restricting tenants from installing or using portable cooling devices of their choosing, with some exceptions. Devices removed from October 1 through April 30.
Dallas, TX	85°F (29.4°C)	Refrigerated air equipment. Dallas, Texas, expanded its rental registry to include single-family homes several years ago. As part of the Minimum Property Standards, landlords must provide and maintain refrigerated air equipment capable of cooling each habitable room to at least 15 degrees cooler than the outside temperature, with a maximum temperature of 85°F.
El Paso, TX	90°F (32.2°C)	El Paso, Texas, has adopted and amended the International Residential Code to require that interior spaces intended for human occupancy be equipped with active or passive heating and cooling systems. These systems must be capable of maintaining an indoor temperature between 68°F and 90°F.
Houston, TX	80°F (26.7°C)	If screens are not provided. In Houston, Texas, the Building and Neighborhood Protection Ordinance requires that each habitable space must have refrigerated air equipment capable of maintaining an interior temperature 20 degrees Fahrenheit lower than the outside temperature or a maximum of 80°F, whichever is warmer.

POLICY RECOMMENDATIONS: RECOMMENDED MAXIMUM SAFE INDOOR AIR TEMPERATURE

The California Department of Housing and Community Development



POLICY RECOMMENDATIONS: RECOMMENDED MAXIMUM SAFE INDOOR AIR TEMPERATURE

This document provides the California State Legislature and interested parties Policy Recommendations on the Recommended Maximum Safe Indoor Air Temperature and related activities conducted by the California Department of Housing and Community Development (HCD) during the 2023 -2024 fiscal year.

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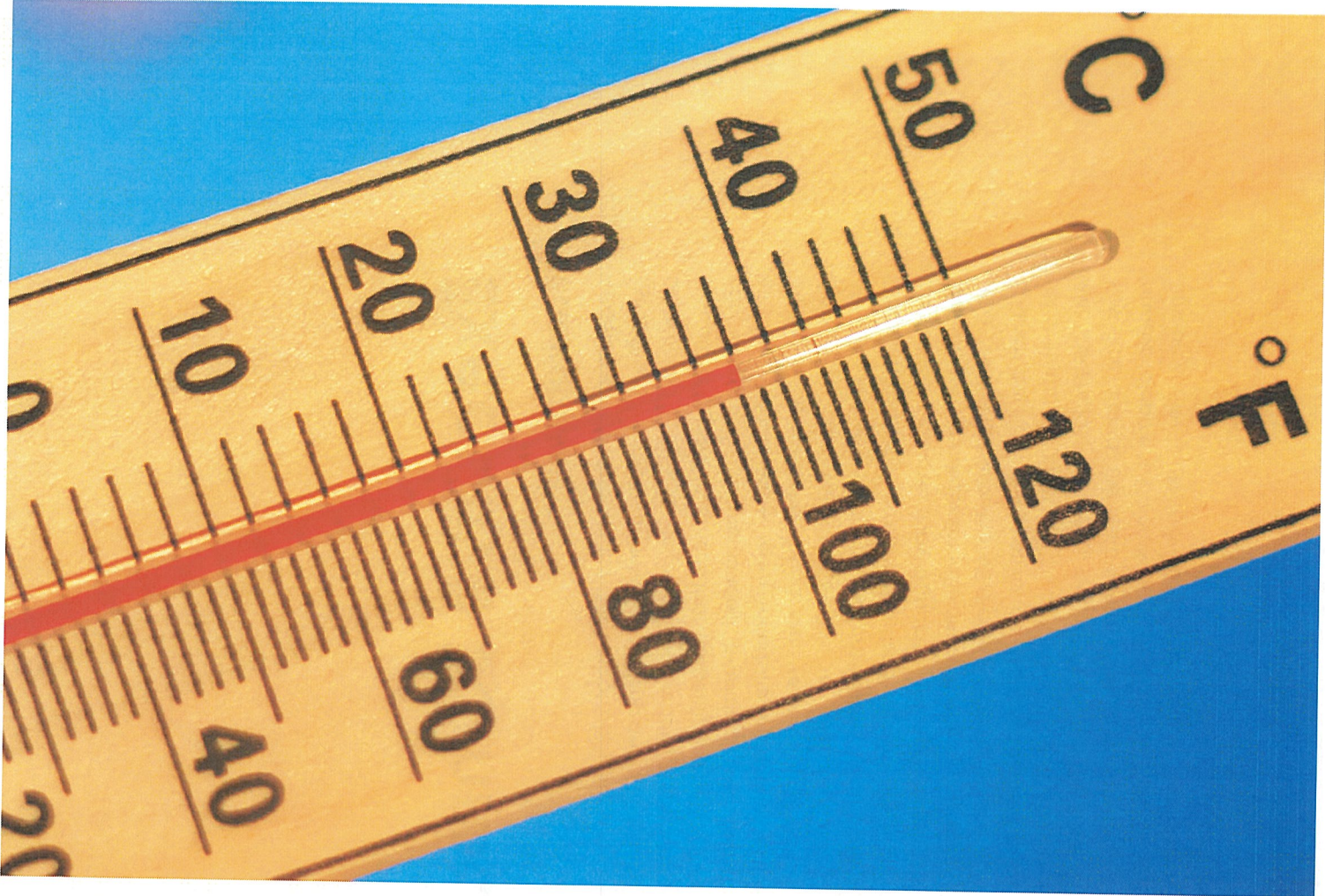
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Executive Summary

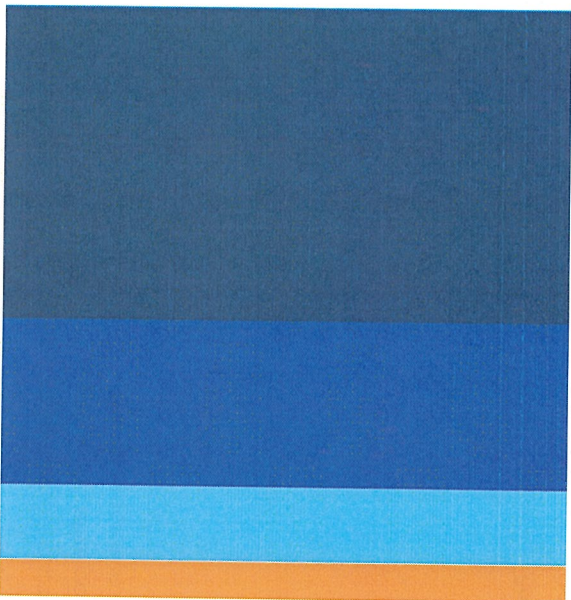
Background

Assembly Bill 209 (Chapter 251, Statutes of 2022), Section 31, (AB 209) requires the Department of Housing and Community Development (HCD) to develop policy recommendation(s) that are designed to ensure that residential dwelling units can maintain a recommended maximum safe indoor air temperature. These recommendations consider state climate goals, the extreme heat plan, regional temperature differences, and various methods for reducing indoor air temperatures, including, but not limited to, technical feasibility, building and site electrical system limitations, cost barriers, electric utility capacity limitations, state and federal statutory requirements, and other relevant factors. HCD contracted with the UC Berkeley Center for the Built Environment (CBE) to support the development of these policy recommendations. As specified in AB 209, HCD consulted with stakeholders including, but not limited to, the State Air Resources Board, the State Energy Resources Conservation and Development Commission, the Office of Planning and Research, the California Building Standards Commission,

the Office of the State Fire Marshal, the State Department of Public Health, local building officials, local code enforcement officers, and community-based organizations, including those working in the areas of housing and health, tenant rights, and environmental justice.

In addition to input from stakeholders, the policy recommendations were developed using an extensive literature review on the impact of high indoor air temperatures on human health. Although there is not a definitive body of research to explicitly determine the maximum safe indoor air temperature for all residential dwelling units in all possible conditions, the policy recommendations are consistent with the research and standards that are currently available. The policy recommendations also include other measures such as incentives and investment, equity, and other areas of research that should be explored.

These policy recommendations are aligned with many of the goals identified in the 2022 California Extreme Heat Action Plan (EHAP).



Policy Recommendations

Maximum Safe Indoor Air Temperature

The state should consider a general maximum safe indoor air temperature of 82 degrees Fahrenheit (27.8 degrees Celsius) for residential dwelling units. Statewide methods to implement this policy recommendation may include building standards for newly constructed residential dwelling units and/or incentive programs for retrofitting existing residential dwelling units, or manufactured homes/mobilehomes (collectively "MH").

Additional Considerations

- When air movement is provided by fans or other mechanical means within residential dwelling units, additional consideration may be provided when establishing a maximum safe indoor air temperature.

- While the proposed maximum safe indoor air temperature is meant to apply to a broad range of the population, including most elderly adults, some people have a higher risk of health impacts from heat. Conditions that are associated with higher heat susceptibility include, but are not limited to, cardiovascular disease, respiratory disease, kidney disease, and poor thermoregulation. There is not sufficient information to establish maximum safe temperatures for specific health conditions and State policy should acknowledge that individuals who require lower temperatures should not be inhibited from making accommodations to meet their needs.

Strategies Based on Unit Type

Newly constructed residential dwelling units

- Consider establishing authority and direction to HCD to research and propose for adoption building standards that require that newly constructed residential dwelling units to be designed and constructed to be able to maintain a maximum indoor air temperature of 82 degrees Fahrenheit (27.8 degrees Celsius).

- Consider incentivizing programs for passive and low energy cooling strategies focusing on the use of cool roofs, cool walls, window shading, building shading and landscaping. Evaluate the use of modeling predictions of future weather data that will better represent the conditions during the lifetime of residential dwelling units rather than historical weather data.

Existing residential dwelling units and MH

- Consider incentive programs to encourage broader adoption and use of fans or whole house ventilation systems as an effective, energy-efficient, and resilient means of keeping people cool.
- Consider incentive programs to encourage the use of room evaporative coolers in climate zones that would support evaporative cooling.

- Consider incentive programs to encourage the use of air conditioning, with current heat pump technology, where feasible and cost effective.

- Increase the heatwave resilience of the existing California residential dwelling units by incentivizing weatherization and passive and low energy cooling retrofit strategies identified in this report.

Newly constructed manufactured homes

- The U.S. Department of Housing and Urban Development (HUD) has preemptive authority for the design and construction of newly constructed manufactured homes. However, the policy recommendations may suggest the submittal of a petition to HUD's Manufactured Housing Consensus Committee to consider the policy recommendations herein, as they may apply to newly constructed manufactured homes produced on or after a future date.

Introduction

Heat is the leading weather-related cause of death in the United States and heatwaves are increasing in frequency, duration, and intensity across the country.

The California Department of Public Health (CDPH) reported 395 excess deaths in California during a 10-day heatwave in September 2022 (CDPH, 2023). A study of the July 2006 California heatwave found there were 16,166 excess emergency department visits and 1,182 excess hospitalizations statewide (Knowlton et al., 2009). The California Fourth Climate Change Assessment estimates that by 2050, heatwave events in the Central Valley could last 2 weeks longer than presently experienced (CDPH, 2018). The same report estimates that urban heat-related deaths could double or triple by the same date.

California residential building standards, based on international/uniform model codes, and state regulations in Title 25 of the California Code of Regulations, have long specified that newly constructed residential dwelling units must be able to maintain a minimum indoor air temperature, yet there is no requirement with respect to a maximum indoor air temperature. The purpose of this report is to identify a recommended maximum safe indoor air temperature for California residential dwelling units and identify strategies for maintaining dwelling indoor air temperatures at or below a safe temperature.

While there is considerable literature on the effects of heat on health, there are various approaches used to establish a maximum safe indoor air temperature. As is true for many environmental hazards, there are gaps in our understanding and there are a significant number of factors that impact

how heat might affect any given person. People adapt to heat through changes in their physiology and behavior. It is also important to note that there are both short-term and long-term impacts of heat health. All these factors add to the complexity of determining what maximum indoor air temperatures are safe.

There can be significant economic and environmental costs associated with keeping residential dwelling units cool, particularly when achieved with mechanical air conditioning. These costs arise from the energy used to operate existing buildings, and in the specification of more expensive equipment and building envelope features in the design of more efficient new buildings. These policy recommendations seek to strike a balance between the benefits of keeping residential dwelling units cool and the costs of doing so. Because there is not sufficient science on the relationship between exposure to high indoor air temperatures and health to develop a rigorous cost-benefit analysis, the approach is to recommend a maximum safe indoor air temperature that is reasonably well supported by existing literature.

In addition to recommending a maximum safe indoor air temperature, this document compiles a set of strategies that can help keep California residential dwelling units at or below that temperature. These include a range of mechanical and passive cooling strategies that are appropriate for California and have been demonstrated to be effective.

The California Energy Commission (CEC) reports that, as of 2021, 65 local jurisdictions (representing just over 10 percent of all jurisdictions) had adopted policies to promote or require building electrification (CEC, 2021). Electrification of

California dwelling units includes increased use of electric heat pump appliances to replace gas furnaces and water heaters for space and water heating. Over time, this has the potential to substantially decrease the risk of residential overheating, assuming that the electric grid remains stable, and residents are able to afford to operate and maintain cooling equipment given that California utility rates are expected to continue to rise in the future (CPUC, 2021). California is aiming to: "Maximize efficiency and electricity energy use across sectors to the greatest extent possible. Provide affordable, accessible, and reliable carbon-free electricity for a highly electrified economy. Decarbonize activities that cannot be electrified by using clean fuels, efficiency, conservation, and better land use planning and infrastructure" (CCST, 2023). The California Council on Science and Technology determined 8 key challenges for California's energy transformation (CCST, 2023); relevant to this report are the challenges related to electrification (1) and grid reliability (3).

The primary tradeoffs that should be considered when establishing a maximum safe indoor air temperature for California residential dwelling units include human health, economic, and environmental impacts. Exposure to high indoor air temperatures can pose health risks across all populations. While conditions that cause acute heat stress at the individual level for healthy individuals have been studied extensively, the impacts of more moderate conditions on the health of large populations are not well understood. This knowledge gap poses a fundamental challenge to establishing maximum safe indoor air temperature guidelines. A lower maximum indoor air temperature may provide increased health benefits at increased capital, energy costs, and environmental impacts. This report

provides rationale for a maximum safe indoor air temperature for California, but the recommendation is not based on a formal health risk assessment because of the lack of sufficient data to support such an analysis. As the understanding of the relationship between indoor air temperature and health improves over time the recommended maximum safe temperature limits should be reevaluated.

New Construction versus Existing Residential Dwelling Units

HCD estimates that there were 14.3 million residential dwelling units in California as of 2021, and during the period of 2020 through 2023, an average of 100,000 new dwelling units were completed each year. New residential dwelling units are generally significantly more energy efficient and over 92 percent of residential dwelling units built after 2012 have mechanical cooling of some type (CEC RASS, 2019). While this report includes a recommended maximum safe indoor air temperature for all residential dwelling units, the majority of the recommendations address the more significant risks associated with existing residential dwelling units and MH stock, particularly important in cases of substandard dwelling units that may contribute to heat vulnerability where people may be more likely to experience heat exposure.

Manufactured Homes and Mobilehomes

MH represent approximately 2 percent of total California residential dwelling units (CEC RASS, 2019). While HUD's federal manufactured home construction and safety standards largely preempt California's ability to regulate the design and construction of new manufactured homes, most of the policies recommended in this report should be considered broadly, including as they may be applied to MH.



Regional Temperature Differences

Temperature variations across the state are significant. The CEC defines 16 distinct climate zones for the purposes of California Energy Code compliance. Table 1 shows the 99th percentile temperatures for the months of May through October for each of these 16 zones. The difference between the coolest zone (Zone 1, Arcata) to the warmest zone (Zone 15, Palm Springs) averages over 40 degrees Fahrenheit. These large differences mean that the overheating risk for residential dwelling units can be very different from one location to another. The analysis of overheating risk and cooling energy use takes these regional variations into account. Some of the policy recommendations are also dependent on aspects of regional climate differences.

These regional differences in temperature also mean that individuals living in different parts of the state may have different levels of acclimatization to heat. In general, people living in warmer regions may be more resilient to heat because of physiological, behavioral, and physical environment adaptations. These adaptations are not sufficiently well understood, particularly among different subgroups of the population, to justify localized maximum safe indoor air temperature recommendations for different regions of the state.

Table 1: 99th percentile outdoor dry bulb temperatures for May through June for CA climate zones.

ZONE	CITY	MAY	JUN	JUL	AUG	SEP	OCT
1	Arcata	59	68	63	73	72	68
2	Santa Rosa	89	96	91	97	91	97
3	Oakland	83	81	81	84	80	88
4	San Jose	90	98	93	98	90	95
5	Santa Maria	81	82	78	76	85	92
6	Torrance	78	83	81	80	82	88
7	San Diego	78	77	79	79	82	86
8	Fullerton	89	91	89	90	95	97
9	Burbank	91	97	91	94	98	100
10	Riverside	93	100	98	98	101	101
11	Red Bluff	99	110	103	108	99	96
12	Sacramento	95	105	100	101	95	95
13	Fresno	98	107	103	106	100	98
14	Palmdale	95	107	102	102	99	96
15	Palm Springs	108	117	112	110	107	108
16	Blue Canyon	77	87	80	88	81	80

California Extreme Heat Action Plan (EHAP)

The 2022 California EHAP outlines a set of strategic actions to address extreme heat. These actions are organized into 4 tracks with a total of 13 goals. The recommended policies in this document are aligned with many of the actions in the EHAP including the following:

Action Track A:

Build Public Awareness and Notification

Goal 1: Build public awareness about extreme heat through targeted communications campaigns

Goal 3: Improve accuracy and accessibility of heat modeling and data to inform decision-makers

Action Track B:

Strengthen Community Services and Response

Goal 1: Invest in social resilience

Action Track C:

Increase Resilience of our Built Environment

Goal 1: Protect critical infrastructure

Goal 2: Support heat resilient and cooler communities through relevant regulations and codes

Goal 3: Invest in cool buildings and surfaces

Goal 4: Utilize science-based frameworks and tools

Action Track D:

Utilize Nature-based Solutions

Goal 1: Promote nature-based solutions to reduce extreme heat risks

AB 209 Stakeholders

AB 209 requires HCD to consult with specific state agency and non-governmental stakeholders to support the development of the policy recommendation(s). The goal was to garner participation from stakeholders in the development of policy recommendations, and to collaborate on research relevant to the scope of AB 209.

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The AB 209 stakeholders, include, but are not limited to, the State Air Resources Board, the State Energy Resources Conservation and Development Commission, the Office of Planning and Research, the California Building Standards Commission, the Office of the State Fire Marshal, the State Department of Public Health, local building officials, local code enforcement officers, and community-based organizations, including those working in the areas of housing and health, tenant rights, and environmental justice. HCD facilitated four AB 209 meetings to obtain input and held a stakeholder comment period for feedback on the draft content for the policy recommendations.

Stakeholder Feedback

Below is a summary of the general feedback HCD received from stakeholders:

- Several stakeholders expressed the importance of including MH in the development of policy recommendations.
- Stakeholders asked that existing residential dwelling units be considered as well as newly constructed residential dwelling units.
- As an option, stakeholders were supportive of passive cooling approaches that were less energy intensive and less costly to operate when compared to mechanical air conditioning.
- Clarify that the proposed maximum safe indoor air temperature should apply to existing dwelling units as well as newly constructed residential dwelling units.
- Include more discussion on the relationship between hotter temperatures and increased air pollution.
- Add more information about hydration, limiting outdoor activities to the coolest hours, and heat warning systems.
- Add more explanations and examples about behavioral and psychological adaptations.
- Change "vulnerable population" to "heat-vulnerable populations".
- Add more information about the effects of heat on mental health, increases in interpersonal violence,

the impact of medication and alcohol on heat stress, and the limitations and challenges for people with physical disabilities in seeking cooler environments during heatwaves.

- Add a definition of "extreme heat events" and whether "heatwave" and "extreme heat event" are interchangeable terms.
- Take into consideration the limitations associated with natural ventilation/night cooling.
- Concern that fans are not effective and may in fact be dangerous to health when outdoor temperatures are high.
- Consider different thresholds for different regions of California.

Note: There were several suggestions that were outside the scope of AB 209, which are not included in the policy recommendations.

Research and Supporting Information

Maximum Safe Indoor Air Temperature

Justification Summary

The proposed maximum safe indoor air temperature is consistent with applicable research and standards identified herein.

ASHRAE Standard 55-2023, *Thermal Environmental Conditions for Human Occupancy* (ASHRAE 55, 2023): This widely used standard defines in detail the environmental conditions required for human thermal comfort. The proposed maximum safe indoor air temperatures represent the upper range of comfort for a person wearing summer clothing at typical metabolic rates within residential buildings. Although thermal comfort is not a direct measure of health, it indicates a state of low heat stress on the body which is unlikely to significantly contribute to health-related illness.

Laboratory research: A recent study (Meade et al., 2024) on the physiological effects on elderly subjects in Canada from an 8-hour exposure to a range of thermal conditions found no significant impacts at 79 degrees Fahrenheit and significant impacts at 88 degrees Fahrenheit and above. No conditions between 79 degrees Fahrenheit and 88 degrees Fahrenheit were evaluated. The study recommends an upper limit of 79 degrees Fahrenheit, but includes the observation that "it is likely that [79 degrees Fahrenheit] is overprotective for individuals living in warmer areas (e.g., tropical or hot, dry climates), and enforcing this limit in those regions could have negative consequences because of current economic and environmental costs of mechanical cooling."

Sleep and health: Sleep quality has direct and important impacts on health. A UK study resulted in a recommendation of 82.4 degrees Fahrenheit (28 degrees Celsius) as an 8-hour average night-time indoor air temperature threshold for most healthy persons and 78.8 degrees Fahrenheit (26 degrees Celsius) for special needs, sick and ill persons (K. J. Lomas & Li, 2023). These threshold temperatures assume that the indoor air is still, without air movement present to cool the occupant.

Susceptible Populations

While the proposed maximum safe indoor air temperatures are meant to apply to a broad range of the population, including most elderly adults, some people have a higher risk of health impacts from heat. Conditions that are associated with higher heat susceptibility include, but are not limited to, cardiovascular disease, respiratory disease, kidney disease, and poor thermoregulation. There is not sufficient information to establish maximum safe temperatures for specific conditions and State policy should acknowledge that individuals who require lower temperatures should not be inhibited from making accommodations to meet their needs.

Heat waves and Future California Climate

Global Warming and Heat Waves

The year 2023 was the warmest year since record-keeping began in 1850 (Rohde, 2024). If the current rate of global warming persists over the next decade, it could lead to irreversible impacts on natural and human systems, including sea level rise and extreme weather events such as heatwaves (IPCC, 2022; Zachariah et al., 2023). The term heatwave is defined by the IPCC as “a period of abnormally hot weather, often defined with reference to a relative temperature threshold, lasting from two days to months” (IPCC Annex II, 2022). Based on (Ostro et al., 2009), any prolonged period of high temperatures usually lasting at least 3 consecutive days, especially accompanied by high nighttime temperatures, may be deemed a heatwave. A modest increase in average temperature and/or temperature variability can lead to relatively large changes in the frequency of extreme heat events. Based on the Centers for Disease Control and Prevention (CDC), most definitions for extreme heat events refer to an extended period of time (several days or more) with unusually hot

weather conditions that potentially can harm human health. The U.S. Environmental Protection Agency defines extreme heat events as “periods of summertime weather that are substantially hotter and/or more humid than typical for a given location at that time of year” (United States Environmental Protection Agency, 2006). The terms heatwave and extreme heat event are interchangeable. Heatwaves are the primary cause of weather-related mortality (Luber & McGeehin, 2008), contributing to approximately 1,000 deaths annually in the US (Khatana et al., 2022; Sarofim et al., 2016). Based on the new estimation from CDC (2024), approximately 1,220 people in the United States are killed by extreme heat every year. From 2010 to 2019, California heatwaves have caused at least 599 deaths and could be up to 3900 deaths based on a recent estimation analysis (Phillips et al., 2021) of heatwaves occurred in inland counties (Ostro et al., 2009; Trent, 2006). Future extreme heat events could kill up to 11,300 Californians annually by 2050.

Future California Climate

In California, temperature records align with global warming trends, showing a 2.5 degrees Fahrenheit (1.4 degrees Celsius) increase in annual average air temperature compared to 1880 (California Department of Water Resources, 2015; Pathak et al., 2018; Witherow, 2022). By the end of the 21st century the average temperature in California could remain at pre-industrial levels if greenhouse gas emissions are substantially reduced; if emissions continue to rise, the temperature increase could reach 8.1 degrees Fahrenheit (4.5 degrees Celsius) (Cayan et al., 2008; Kunkel, 2022). These projections are based on climate models that focus on annual average temperature changes.

However, average annual temperature rise does not fully capture the extent of heat stress because summer temperatures are rising faster than winter temperatures (California Department of Water Resources, 2015; Witherow, 2022). In addition, nighttime temperatures are rising faster than daytime temperatures, which reduces nighttime relief during heatwaves (Bumbaco et al., 2013; Gershunov et al., 2009; Guirguis et al., 2014).

The impact of global warming is not uniform across California due to its complex topography and large latitudinal extent (LaDochy et al., 2007). Since 1950, the number of daytime heatwaves has increased the fastest in Southern California (Tamrazian et al., 2008), but the number of nighttime heatwaves has increased the fastest in Northern California (Witherow, 2022). Although inland and urban regions are warming faster than coastal and rural areas (Pathak et al., 2018), coastal regions face greater adverse health impacts from rising temperatures due since they are less acclimatized and air conditioning is less common (Gershunov & Guirguis, 2012).

Review of Existing Temperature Standards and Codes

Minimum indoor air temperature thresholds are well-established in the existing state, national, and international standards and codes (World Health Organization, 2018). Maximum indoor air temperature standards are much less common (although there is currently considerable activity on this topic in many parts of the U.S. and internationally) and those that do exist vary greatly and their scientific basis is not well documented. The World Health Organization (WHO 2018) makes only a conditional recommendation that "strategies to protect populations from excess heat should be developed and implemented", with no specific temperature guidelines provided.

U.S. Standards and Codes

Care facilities

Although currently there are no U.S. federal standards that directly address the maximum indoor safe air temperatures for residential dwelling units, Section 483 of Title 42 of the U.S. Code of Federal Regulations (42 CFR 483.10(i)(6)) specifies that long term care facilities must maintain indoor air temperatures between 71- and 81-degrees Fahrenheit. In the document State Operations Manual Appendix PP - Guidance to Surveyors for Long Term Care Facilities, further guidance is provided:

While facilities certified after October 1, 1990, are required to maintain an air temperature range of 71-81°F, there may be brief periods of time where that temperature falls outside of that range only during rare, brief periods of unseasonable weather. This interpretation would apply in cases where it does not adversely affect resident health and safety, and facility staff took appropriate steps to ensure resident comfort. This would enable facilities in areas of the country with relatively cold or hot climates to avoid the expense of installing equipment that would only be needed infrequently.

Occupants of healthcare or long-term care facilities are generally considered more susceptible to heat than the general population due to age and/or underlying health conditions.

Several states, including California, Texas, Georgia, and Washington, have set state-level regulations for the highest temperatures allowed in healthcare facilities. California Title 22, Division 6, Chapter 8 (Residential Care Facilities For The Chronically III) Section 87303(b)(2) includes the following requirement:

The facility shall cool rooms to a comfortable range, between 78 degrees F (26 degrees C) and 85 degrees F (30 degrees C), or in areas of extreme heat to 30 degrees F less than the outside temperature."degrees F less than the outside temperature.

Local Codes for Residential Dwelling Units

At the city and county level in many states, numerous codes define indoor air maximum temperatures for residential dwelling units, summarized in Table 2, organized from highest to lowest. Local standards may be more restrictive than the applicable statewide building standards. Some local standards enable renters to require landlords to install cooling equipment if indoor air temperatures exceed these thresholds.

In most city/county, both active and passive cooling systems are considered acceptable strategies to maintain

the indoor air room temperature below the established thresholds. Additionally, some cities/counties provide alternative maximum temperature thresholds for buildings that adopt specific cooling systems. For example, in Phoenix, residential buildings are required to maintain the indoor air temperature below 86 degrees Fahrenheit (30.0 degrees Celsius) with evaporative cooling systems, or below 82 degrees Fahrenheit (28.0 degrees Celsius) with air conditioning systems (City of Phoenix, 2023). Evaporative cooling systems, which rely on water evaporation, may not achieve temperatures as low as those possible with air conditioning systems. However, they are both effective and energy-efficient in dry climates, offering a more affordable alternative to air conditioning systems.

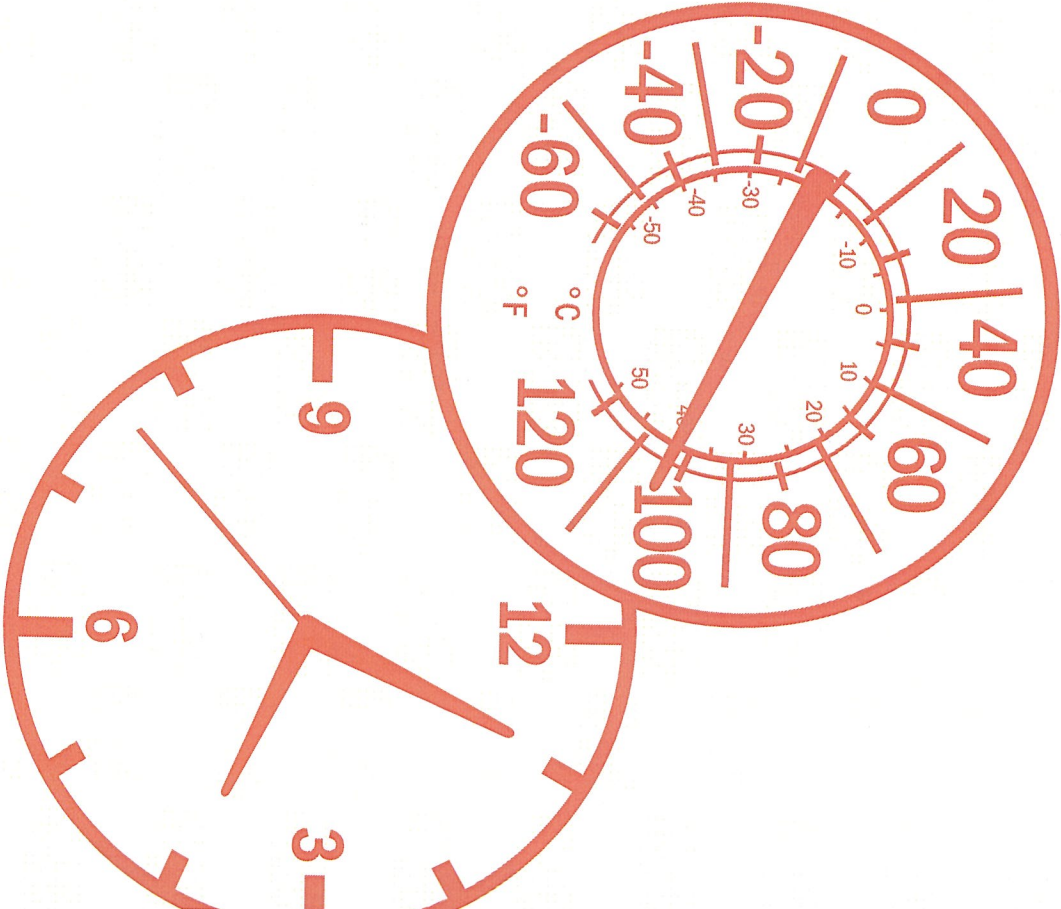
Table 2: Maximum Indoor Air Temperatures for Selected U.S. Local Codes

STATE	CITY	MAXIMUM INDOOR AIR TEMPERATURE
TX	El Paso	90 °F (32.2 °C) (City of El Paso, 2023)
TX	Dallas	85 °F (28.4 °C) (City of Dallas, 2024)
NV	Clark County	85 °F (28.4 °C) (Clark County, 2024)
AZ	Tempe	82 °F (27.8 °C) (City of Tempe, 2024)
AZ	Phoenix	82 °F (27.8 °C) (City of Phoenix, 2023)
AZ	Tucson	82 °F (27.8 °C) (City of Tucson, 2024)
TX	Houston	80 °F (26.7 °C) (City of Houston, 2022)
CA	Palm Springs	80 °F (26.7 °C) (City of Palm Springs, 2023)
LA	New Orleans	80 °F (26.7 °C) (City of New Orleans, 2024)
MD	Montgomery	80 °F (26.7 °C) (Montgomery County, 2024)
OR	Portland	78 °F (25.6 °C) (City of Portland, 2024)

For additional information see Appendix A.

Exposure Time

Although the length of time that a person is exposed to heat significantly impacts possible negative health consequences, this relationship is not well established. Some standards specify maximum lengths of time that a temperature can be exceeded. Others combine time and temperature using the concept of degree-hours, where exposure to a temperature 2 degrees above a threshold for 1 hour is considered equivalent to a 2 exposure at a temperature 1 degree above the threshold. Other standards, like Title 42 Section 483 mentioned above, acknowledge that temperatures can occasionally be above a specified threshold without specific quantitative guidance.



Heat and Human Physiology

The goal of this work is to establish health-based policy recommendations for the maximum safe indoor air temperature of California residential dwelling units.

Understanding the underlying physiology of how humans are affected by heat is an important component of developing the policy recommendations.

Humans have evolved sophisticated mechanisms to maintain a nearly constant core body temperature over a wide range of environmental conditions. To maintain a constant core temperature, internal metabolic heat production needs to be in balance with heat loss to the environment. In cold environments, thermoregulation responses include reducing blood flow to the skin and to the extremities (vasoconstriction) and shivering. In hot environments, humans increase blood flow to the skin and extremities (vasodilation) and, when this is insufficient to maintain core temperature, increase their sweat production to lose more heat through evaporation. In a “neutral” thermal environment blood vessels dilate or constrict to adjust blood flow and the associated heat loss from the skin, sweating is minimal and does not result in wet skin, and no shivering takes place. In such an environment the thermal stress on the body is at a minimum and the thermoregulatory system can easily maintain a constant core temperature (homeostasis). Such conditions result in subjective sensations of thermal comfort.

Although air temperature is often used as a proxy to describe thermal environments, physiologists and building scientists use four environmental and two personal factors to more fully characterize how an environment affects the

body's heat balance. The environmental factors are air temperature, mean radiant temperature, air speed, and humidity. The personal factors are activity (as it impacts metabolic rate) and clothing.

Air temperature and air speed affect human body heat loss to the surrounding air (referred to as convection). The heat loss is proportional to the temperature difference between the body's surface and the surrounding air temperature, and also to the air speed near the body. The colder the ambient temperature and the higher the air speed, the greater the heat loss. When the ambient temperature is higher than the body's surface temperature, the body instead gains heat by the same mechanisms. This convective gain is in most situations greatly exceeded by the simultaneous heat loss caused by sweat evaporation from the skin, which takes place even without the skin being perceived as wet. The use of air movement to keep people cool in hot weather goes back thousands of years, and electric fans are widely used in residential buildings because of their ability to maintain thermal comfort using far less energy than mechanical air conditioning systems.

In an indoor environment, **mean radiant temperature (MRT)** can be thought of, as a first approximation, as the average temperature of the surfaces surrounding a person. Humans exchange heat with surrounding surfaces through longwave radiation, which is driven primarily by the temperature difference between the body's surface and surrounding surfaces, the view factors to those surfaces, and the surface thermal properties. Sitting next to a cold window or in front of a warm fire are examples where radiation can play an

important role. In typical residential environments when cooling is needed, MRT is very close to the air temperature when walls and windows are insulated and shaded. Exceptions include sitting next to large glass surfaces or upper story apartments with poorly insulated roofs or west-facing walls, in which ceiling or wall temperatures can become hot from solar gain.

Humidity in the air acts to reduce the rate at which sweat evaporates from the skin. Sweating is initiated either at high ambient temperatures, high activity levels, or both. When the air humidity is high, the reduced cooling effectiveness of sweating increases the thermal load on the body for a given air temperature or activity level.

Although high humidity levels during warm weather are unusual in California, if indoor relative humidity is above 60 percent, the maximum safe indoor air temperature is lower, as shown in Table 3, in next column. Some climate models predict that coastal humidity may rise due to climate change (Pierce et al., 2018).

Table 3. Impacts of humidity levels in residential dwelling units with and without mechanical air movement.

INDOOR RELATIVE HUMIDITY	WITHOUT AIR MOVEMENT (DEGREES FAHRENHEIT)	WITH AIR MOVEMENT (DEGREES FAHRENHEIT)
below 60%	82	86
60% - 69%	81	85
70% - 79%	80	84
80% - 89%	79	83
90% or above	78	82

Note: Temperatures shown represent equivalent thermal heat loads based on Standard Effective Temperature (SET) defined in ASHRAE Standard 55-2023, Thermal Environmental Conditions for Human Occupancy (ASHRAE 55, 2023).

Activity level and clothing will directly impact heat balance (for example, higher activity level results in higher internal heat production, and more clothing reduces heat loss to the environment) and therefore how a person perceives their thermal environment. In residential buildings people tend to have more flexibility in their clothing selection and can more easily adapt to heat.

Several indices have been developed to combine two or more of these environmental factors into a single number. Some of these indices are primarily intended to gauge the effect of outdoor weather; heat index and humidex combine air temperature and humidity, wind chill factor combines air temperature and air speed, and wet-bulb globe temperature (WBGT) combines all four environmental factors with the addition of solar radiation.

For indoor conditions, comfort engineers use SET which is based on a model of human response to the thermal environment. It is presented in the ASHRAE thermal comfort standard (ASHRAE 55, 2023). SET is defined as: "the temperature of a hypothetical isothermal environment at 50 percent relative humidity, average air speed less than 0.1 m/s (20 fpm), and dry-bulb air temperature equal to mean radiant temperature, in which the total heat loss from the skin of an imaginary occupant wearing clothing, standardized for the activity concerned, is the same as that from a person in the actual environment with actual clothing and activity level".

SET can be used to compare the heat load on the body between two sets of environmental conditions with different air temperature, mean radiant temperature, air speed, and/or humidity. Such combined environmental conditions surrounding the body can be described more simply as 'ambient' temperatures.

In excessively hot or hot and humid environments, heat loss from the body can be reduced below the level of heat production on the body. Over the duration of heat exposure, the cumulative imbalance between heat production and heat dissipation leads to an increase in body core temperature (Cramer & Jay, 2016; Ravanelli et al., 2015).

As the thermoregulatory system responds to a warm ambient environment, physiological changes take place in the body including: (a) Elevated heart rate, (b) Increased blood flow, (c) Increased sweating and moisture loss, (d) Elevated core temperature.

These changes, in the extreme, can lead to immediate health risks including heat cramps, heat exhaustion, heatstroke and dehydration. In turn, these effects can lead to heart, respiratory and organ complications.

Heat and Health Effects

There is conclusive evidence of links between high outdoor temperatures and human health. Outdoor temperature data is widely available and large-scale studies have been conducted that correlate outdoor temperatures and their duration to regional data on health, hospital admissions and death (Basu, 2009; Basu & Samet, 2002b; World Health Organization, 2018). Indoor air temperature data, on the other hand, is not typically available and there is significantly less research relating indoor air temperatures to health.

High temperatures have been estimated to have caused 489,075 global deaths annually throughout the 2000-2019 period (Zhao et al., 2021). This is likely an underestimate due to limitations in reporting and cause attribution. Both mortality (deaths) and morbidity (illness) are expected to rise with the increase in global temperatures, estimated as 3.3 to 5.7 degrees Celsius by the year 2100 (Kiarisi et al., 2023). The effects of high temperatures are most pronounced during heatwaves, periods of peak temperature within a climate's natural variability. The length and severity of these peak events is also being influenced by changes occurring in the climate.

Heat Strain

Heat strain is the condition where the body cannot dissipate sufficient heat to maintain normal core body temperature and can lead to several heat-related disorders.

Heat Exhaustion

Extended periods of heat stress may result in heat exhaustion, with possible symptoms of dizziness and weakness, syncope, intense thirst, gastrointestinal symptoms, and dehydration (Gauer & Meyers, 2019; Hess et al., 2023). Heat exhaustion is typically associated with core temperatures between 101 and 104 degrees Fahrenheit (Hanna & Taft, 2015).

Heatstroke

If core temperature rises above 104 degrees Fahrenheit, heatstroke is likely to occur. Symptoms consist of inhibited perspiration, rapid pulse, altered mental state and potential loss of consciousness. Chronic health outcomes in relation to multiple organ system damage include cognitive impairment, acute renal failure, rhabdomyolysis, liver dysfunction with hepatic enzyme elevation, disseminated intravascular coagulation, and acid-base disturbances (Glazer, 2005; Sutton, 1909).

Heatstroke can be divided into classic and exertional forms. Classic heatstroke is caused by environmental exposure that results in core body temperature above 104 degrees Fahrenheit. This condition primarily occurs in the elderly and those with chronic illness and can develop slowly over several days. Exertional heatstroke is a condition that primarily affects younger individuals who are actively exercising and core temperature increases due to a combination of high heat generation and environmental conditions (Glazer, 2005).

Heat and Pre-Existing Health Conditions

Heat-related mortality and morbidity can generally be attributed to increased bodily strain and dehydration as the body expends additional energy to maintain core temperature. Those with pre-existing conditions such as cardiovascular disease, kidney disease, respiratory disease, diabetes, and hypertension have a higher risk for adverse outcomes. Such conditions are modulated by other risk factors such as sex, age, smoking status, activity levels, medication usage, and socioeconomic status. Heat has also been associated with elevated deaths from ischemic heart disease, stroke, COPD, lower respiratory conditions, dementias, diabetes mellitus and diarrheal disease.

Several physiological factors influence an individual's susceptibility to heat-related health issues:

Ability to sweat: A diminished ability to sweat (anhidrosis) can lead to reduced heat dissipation and ability to adapt to temperature variations (Inoue & Shibasaki, 1996).

Although the number of sweat glands responsive to thermal stimuli remains constant with age, the output per gland in response to changes in body temperature or certain stimuli decreases in older individuals (Inoue & Shibasaki, 1996).

Nerve damage, including from diabetes or alcoholism, can contribute to this condition.

Vasodilation and blood flow: The body dissipates heat through the skin via cutaneous vasodilation, where blood vessels in the skin expand, allowing more blood to flow near the surface and release heat to the environment (Chen et al., 2024; Inoue & Shibasaki, 1996). Changes in skin properties related to aging tend to decrease skin blood flow.

Respiration: Heat causes increased respiratory rate and bronchodilation which can exacerbate symptoms like shortness of breath and asthma.

Sensitivity and nervous system: The brain and nervous system are crucial to human thermophysiology and regulation. The hypothalamus detects changes in the body's thermal state from changes in blood temperature and by peripheral inputs from thermosensitive receptors located in the skin and in the muscles (Nagashima, 2006). Various inflammatory and neurodegenerative conditions that interfere with the flow of information from the peripheral to central nervous system, specifically hypothalamic dysfunction, and/or motor control such as multiple sclerosis, stroke, Parkinson disease, and peripheral neuropathy can reduce the ability to respond to changes in temperature (Steinmetz, 2024).

Cardiovascular Disease

For individuals with preexisting cardiovascular conditions such as hypertension or heart failure, the physiological response to heat places additional strain on the heart and can lead to both acute and chronic illness (Epi et al., 2021). The association between cardiovascular mortality and temperature forms a U-shaped curve where the incidence of mortality increases at low and high ambient temperatures (Arnold et al., 2022).

Heat-related cardiovascular hospitalizations appear to be dependent on location, climate, and socioeconomic status (C. Liu et al., 2015). Increased ambient temperatures in California have been associated with increased risk of hospitalization for cardiovascular disease, ischemic heart disease and ischemic stroke (Holmes et al., 2016).

Respiratory Disease

Respiratory diseases can be exacerbated by heat stress (Tham et al., 2020). The physiological mechanisms underlying this vulnerability stem from the body's effort to cool itself through increased respiration and pulmonary vasodilation. For individuals with preexisting respiratory conditions such as chronic obstructive pulmonary disease (COPD) or asthma, this response can be detrimental. The increased respiratory rate and bronchodilation can exacerbate symptoms like shortness of breath and wheezing. Respiratory diseases, specifically COPD, have been cited as a leading cause of death in relation to heat exposure as a result of inflammatory mechanisms and dehydration (McCormack et al., 2016). Increases in maximal daily indoor air temperature have been associated with worsening of COPD symptoms and with increases in the frequency of inhaler use (McCormack et al., 2016). Through the investigation of threshold relationships between temperature and heat-related hospital admissions, researchers found that outdoor temperatures above 89.1 degrees Fahrenheit (31.7 degrees Celsius) were correlated with increased respiratory hospital admissions (Lin et al., 2009).

Diabetes

Diabetes is another condition that can be exacerbated by heat exposure (Tham et al., 2020). Heat can accelerate the absorption of insulin in individuals with diabetes, potentially leading to hypoglycemia (Rönnemaa & Koivisto, 1988). In addition, people with type 2 diabetes mellitus have lower skin blood flow and sweating responses that compromise the body's ability to dissipate high heat exposures (Uejio et al., 2022). Diabetes emergency calls have been associated with high outdoor temperature (Holmes et al., 2016).

Kidney Disease

Kidneys play a major role in thermoregulatory functions. These functions include blood pressure regulation and the maintenance of fluids and essential body chemicals. Prolonged dehydration and reduced blood flow contribute to the risk of acute or chronic kidney disease (CKD) where the effects are generally acute (de Lorenzo & Liaño, 2017; J. Liu et al., 2021). Heatwaves increase the likelihood of developing kidney failure, which includes acute kidney injury (AKI) or CKD, and other outcomes such as acute renal failure, kidney stones, renal colic, abnormal kidney function, and kidney tumors (J. Liu et al., 2021).

Obesity

Obese individuals have a lower ratio of body surface area to body mass which reduces the amount of heat they can dissipate from their skin relative to the metabolic heat they generate. Fat tissue is also a better thermal insulator than muscle tissue which can reduce heat transfer from the body core to the skin. Obese individuals are also at greater risk of cardiovascular events during heatwaves (Meade et al., 2020). Obese older adults were twice as likely to die during the 2003 European heatwave compared to their non-obese counterparts (Vandentorren et al., 2006). Heatstroke has been observed to occur at a rate 3.5 times higher in obese or overweight individuals compared to those of normal weight (Henschel, 1967).

Physical Disabilities

Physical disabilities significantly impact an individual's susceptibility to indoor heat, primarily due to alterations in thermoregulatory perception and response mechanisms. Individuals with physical disabilities may experience reduced thermal perception, vaso-control of body skin temperature, and sweating efficiency (Hill et al., 2000). Medications required for treating physical disabilities can affect thermoregulatory responses. One's heat-vulnerability during heat extremes is also associated with being confined to bed, living alone, being unable to care for oneself, and not leaving the residence to cool down body temperature. Additionally using technical aids, such as wheelchairs, may affect an individuals' ability to independently manage thermal discomfort.

Medications and Alcohol

Drug use can change the body's ability to redirect blood flow to the skin to cool the body or to increase sweating, thus increasing the risk of dehydration or decreasing sweating, in turn making it harder for the body to cool off since the cutaneous vasodilation and evaporative cooling are the two primary ways for the body to lose heat. Havenith (2005) states that the "use of drugs such as alcohol may predispose subjects to heat illness by changes in physiological effector mechanisms and by changes in behavior. Many drugs affect the body fluid balance, vasoconstrictor/dilator activity and on cardiac function. These include alcohol, diuretics, anti-cholinergic drugs, vasodilators, antihistamines, muscle relaxants, atropine, tranquilizers and sedatives, beta-blockers and amphetamines.

Cognitive Disabilities

For those with cognitive disabilities, difficulties in comprehending the severity of heat stress, recognizing signs of overheating, such as early dehydration, or effectively communicating their discomfort place them at heightened risk (Ormandy & Ezratty, 2012). Furthermore, these individuals might have limited mobility, making it challenging to seek relief in cooler environments during heatwaves.

People with dementia are considered susceptible to heat due to several factors related to the pathology of their condition and its impact on thermoregulation and thermal perception. Research has also found significant variation in both tympanic and rectal temperatures in older adults with dementia, with dementia being significantly related to lower body temperatures. This variation indicates that individuals with dementia may have different thermal needs and sensitivities. Individuals with dementia often dress inappropriately for the temperature (Van Hoof et al., 2010). There is evidence that agitation of residents with dementia can increase with higher indoor air temperature (Tham et al., 2020), and that enhancing thermal comfort can significantly decrease agitation and behavioral disturbances (Tartarini et al., 2017).

Elderly

Aging impacts the skin's vasodilatory response and cutaneous blood flow, reduces sweat gland effectiveness, cardiac fitness and thermal sensitivity. These changes compromise the ability to regulate body temperature and to accurately detect temperature variations (Chen et al., 2024; Inoue & Shibasaki, 1996). The elderly population frequently has other health conditions such as cardiovascular or

respiratory diseases which impact their susceptibility to heat as described above. Limited mobility among older adults may hinder their ability to seek cooler environments during extreme heat events (Basu & Samet, 2002a; Ormandy & Ezratty, 2012; Tham et al., 2020). Additionally, factors such as difficulties in operating windows and blinds contribute to their increased vulnerability (K. Lomas, 2021). A study of elderly people (average age 80.9 years) found that gait speed, chair-rise rate and balance were negatively impacted above 27.9°C (Lindemann et al., 2017)

Pregnancy

Adverse pregnancy outcomes have been widely studied in relation to high ambient temperatures, including low birthweight, stillbirth, preeclampsia, and congenital abnormalities (Rekha et al., 2023). The physiological mechanisms related to high ambient temperatures can affect placental blood flow, increasing the risk of hypertensive crises and stillbirth (Rekha et al., 2023; Shashar et al., 2020). Maternal sweating and arginine vasopressin-mediated renal fluid reabsorption as thermoregulatory mechanisms in response to overheating have also been associated with preterm labor (Syed et al., 2022). Long-term, repeated exposure to high temperatures can result in several adverse pregnancy outcomes. Cumulative exposure of 5 to 15 days to outdoor temperatures above 86 degrees Fahrenheit (30 degrees Celsius) has been associated with infant congenital heart defects (Lin et al., 2018).

Infants and Young Children

Underdeveloped thermoregulatory systems, high metabolic rates and limited ability to dissipate heat make infants and

young children susceptible to overheating. The inability to communicate discomfort further complicates their vulnerability (Basu & Ostro, 2008). Epidemiologic studies have shown that infants and children aged five or younger are at increased risk of mortality from high indoor air temperatures (Basu & Ostro, 2008; Tham et al., 2020). A study focusing on infant deaths in California during the warm season also found an increased risk of infant mortality as ambient temperature increased (Basu et al. 2015).

Other Impacts of Heat Impacts on Cognitive Function and Accidents

When core temperatures reach 101.8 degrees Fahrenheit (38.8 degrees Celsius), the capacity for physical work diminishes, mental activity is impaired and accident risk increases (Walter & Carraretto, 2016). A study in China found that math test scores on a day with average temperatures above 89.6 degrees Fahrenheit (32 degrees Celsius) were slightly lower than scores on days with average temperatures between 71.6- and 75.2-degrees Fahrenheit. This effect was more pronounced in regions that are typically cooler (X. Zhang et al., 2023).

Heat is hypothesized to directly increase feelings of hostility and indirectly increase aggressive thoughts and is mediated by affect (B. G. Anderson & Bell, 2009). Higher temperatures have been associated with more penalties for aggressive behavior in professional football (Craig et al., 2016), pitchers hitting batters in professional baseball (Krenzer & Splon, 2018), and horn honking at cars not moving at green lights (Kenrick & MacFARLANE, 1986).

Impacts on Mental Health

Psychological distress can promote negative mental health and behavioral outcomes. When analyzing self-reported major depressive disorder in over 20,000 participants across 106 countries, Mason and colleagues found a strong relationship between higher body temperature and depression symptom severity (Mason et al., 2024). When assessing hospital admissions attributed to mental, behavioral, and cognitive disorders in South Australia, there was a reported 7.3% increase in admissions when outdoor ambient temperatures were above a threshold of 80.1 degrees Fahrenheit (26.7 degrees Celsius), with a statistically significant effect noted in organic illnesses, dementia, mood affective disorders, neurotic, stress related, somatoform disorders, disorders of psychological development, and senility (Hansen et al., 2008).

To date, studies investigating the relationship between high temperatures and violence are preliminary. Some suggest that hot weather induces interpersonal violence by increasing discomfort, frustration, impulsivity, and aggression, and that changes in ambient temperature can alter people's routine activities (e.g., outdoor events and social contacts), leading to increased interpersonal conflicts (Mahendran et al., 2021). Physiologically, heat can disrupt sleep and impair the function of vital neurotransmitters and hormones. Additionally, incidents of alcohol, cocaine, and drug overdoses increase as temperature increases. These factors link the climate crisis to a mental health crisis.

Among mental illnesses, schizophrenia has been identified as heat sensitive by different authors, who highlight an increase in the core symptoms of people with a schizophrenia

diagnosis associated with high indoor air temperatures (Naughton et al., 2002). Additionally, it has been stated that in some cases there is an increase in summer admissions of schizophrenia patients to psychiatric facilities (Shiloh et al., 2007) and in deaths due to schizophrenia and schizotypal and delusional disorders (Hansen et al., 2008). The findings from Shiloh et al. suggest that the primary psychotic symptoms associated with schizophrenia, such as delusions and hallucinations, are influenced by temperature fluctuations. These symptoms may intensify under the stress of excessive environmental heat or potentially diminish in cooler conditions.

Impacts on Sleep

Sleep is one of the three key pillars of health (alongside exercise and nutrition) and is known to be affected by heat exposure (He et al., 2022; Romanello et al., 2022). Unusually warm night-time temperatures have been linked to an increased frequency of nights with insufficient sleep (Obradovich et al., 2017). Cumulative heat exposure and its impact on sleep will be exacerbated by climate change, as night-time temperatures are warming faster than daytime temperatures in many parts of the world (Cox et al., 2020).

Insufficient sleep is a recognized risk factor for numerous adverse physical and mental outcomes. Multiple undesirable health outcomes are associated with insufficient sleep (Luyster et al., 2012). They include reduced cognitive performance, diminished productivity, compromised immune function, adverse cardiovascular outcomes, depression, anger, and suicidal behavior (Milnor et al., 2022). A review by Itani (Itani et al., 2017) highlighted nine major health outcomes linked to short sleep duration:

hypertension, cardiovascular disease, stroke, diabetes mellitus, coronary heart disease, obesity, dyslipidemia, depression, and mortality. Other studies have found a causal link between lack of sleep and Alzheimer’s and cancer (Walker, 2017). Sleep loss not only degrades mental health but also reduces workplace productivity, increases absenteeism, and elevates the risk of accidents (Hillman et al., 2018). Therefore, insufficient sleep undermines independent living and places an increased burden on the health and social care system (K. J. Lomas & Li, 2023).

Temperature and Sleep Quality

Many factors affect sleep quality, including physiological, psychological, and environmental conditions. Among the key environmental factors, temperature and noise have been identified as the most influential (N. Zhang et al., 2019). In hot weather, the thermal environment during sleep becomes crucial because a lack of night-time relief from heat is considered a significant factor contributing to heat-related mortality (Murage et al., 2017; Sheridan & Kalkstein, 2004). Based on an association between high morning temperatures and deaths to heat exposure, Anderson (M. Anderson et al., 2013) stated that small diurnal temperature variations (meaning little drop in temperature at night) contribute to mortality. During the Chicago heatwave of 1995, with approximately 700 excess deaths, there were exceptionally high minimum temperatures that persisted for several days. These high minimum temperatures inhibited the normal recovery from heat stress during the nighttime hours (Kenney et al., 2014).

In the UK, an overheating criterion has been proposed based on the mean night-time bedroom temperature, with thresholds ranging between 78.8 and 84.2 degrees

Fahrenheit (26 and 29 degrees Celsius), depending on bedding and comfort expectation (K. J. Lomas & Li, 2023). The allowable exceedance of the chosen threshold is limited to seven nights between May and September. Using the three adaptation categories provided in the TM59 standard and analyzing the exceedance hours, the authors recommend adopting thresholds based on population types: 78.8 degrees Fahrenheit (26 degrees Celsius) for special needs populations (sick and ill people), 80.6 degrees Fahrenheit (27 degrees Celsius) for people with disabilities, children, and elderly people, 82.4 degrees Fahrenheit (28 degrees Celsius) for most healthy people, and 84.2 degrees Fahrenheit (29 degrees Celsius) for robust and healthy young people.

Table 4. Suggested night-time temperature threshold in a proposed UK standard (K. J. Lomas & Li, 2023) (based on still air conditions).

MEAN NIGHT-TIME TEMPERATURE THRESHOLD	BEDROOM COMFORT EXPECTATION
78.8 °F (26 °C)	Very high expectation (e.g., special needs, sick and ill persons)
80.6 °F (27 °C)	High expectation (e.g., disabled, children and elderly persons)
82.4 °F (28 °C)	Medium expectation (e.g., most healthy persons)
84.2 °F (29 °C)	Moderate expectation (e.g., robust, young healthy persons)
>84.2 °F (>29 °C)	Unacceptable for any persons

Heat Combined with Poor Air Quality

Atmospheric pollution can impact the risk of heat exposure. While most studies have considered air temperature and air pollutants separately, more recent evidence has shown the amplifying effect of both exposures simultaneously on health impacts. One study, for example, using daily average exposure of heat and daily weighted concentrations of air pollutants across neighborhoods in Rotterdam, Netherlands, found a significant effect modification between maximum temperature and air quality metrics on natural-cause mortality (Willers et al., 2016).

These findings align with results from similar studies conducted in Italy and Germany (Breithner et al., 2014; Scottichini et al., 2018). A Slovenia study also found that worse cardiovascular symptoms with higher heat burden and CO₂ concentration (Fink et al., 2017). A study in Jiangsu, China, provides a comprehensive picture of the interactions between high extreme temperatures and PM_{2.5} pollution on total mortalities (Zhou et al., 2023). The interactions were stronger in respiratory than cardiovascular mortalities. Researchers note that such risks can vary between neighborhoods due to local differences in both heat and air pollution (Willers et al., 2016).

Fine particulate matter (PM_{2.5}) and tropospheric ozone are significant pollutants causing cardiovascular and respiratory diseases, and the relationship is influenced by heat. PM_{2.5} alone was responsible for 3.15 million premature deaths worldwide in 2010 and 52,000 in the United States (Giannadaki et al., 2016). Numerous recent multi-city studies report the mortality effects of ozone (Bell

et al., 2004). Volatile organic compounds (VOCs) are precursors to both pollutants. PM_{2.5} is a secondary organic aerosol that forms through the oxidation of VOCs. Ozone is formed from photochemical reactions involving nitrogen dioxide (NO₂) and volatile organic compounds (VOCs) in the presence of sunlight, particularly ultraviolet light. Particularly relevant to this report is that these reactions increase with air temperatures (Pfannerstill et al., 2024).

The percentage of days when PM_{2.5} exceeds a threshold level of 12 µg/m³ increases from less than 10 percent at 68 degrees Fahrenheit (20 degrees Celsius) to more than 40 percent at 68 degrees Fahrenheit (30 degrees Celsius). The temperature dependence of ozone is very strong. The ozone exceedances of the 70 ppb unhealth threshold defined by standards increase from 0 percent at 86 degrees Fahrenheit (20 degrees Celsius) to more than 70 percent at 68 degrees Fahrenheit (30 degrees Celsius) (Nussbaumer & Cohen, 2020, 2021). Sunny, hot afternoons are ideal for ozone formation, especially since hotter air tends to be more stagnant. Most tropospheric ozone originates from vehicle exhaust and emissions from factories, power plants, and refineries.

Poor air quality can also limit the use of natural ventilation to provide cooling when outside temperatures are below indoor air temperatures. This is particularly true during periods of heavy wildfire smoke.

Social equity factors Individuals with low socioeconomic status may be particularly subject to the adverse effects of extreme heat. These populations often face a combination of socioeconomic and environmental factors that amplify their personal susceptibility or circumstantial vulnerability to heat-related health risks (Basu et al., 2015; Basu & Ostro, 2008).

Lower quality dwelling units. Individuals with low socioeconomic status are more likely to reside in substandard dwelling units, which usually lacks adequate insulation or ventilation, exacerbating indoor air temperatures during heatwaves.

Limited access to cooling. One significant reason for this is that limited financial resources can further impede access to more effective cooling strategies.

Social isolation. Research has found that individuals living alone faced a doubled risk of death during heatwaves compared to those living with others (Semenza et al., 1996).

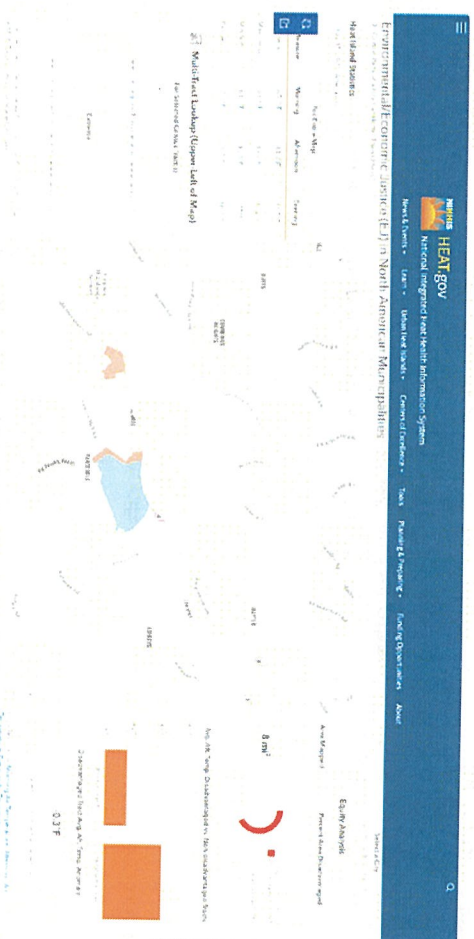
The concerns for individuals who live alone during heat emergencies, particularly the elderly, is underscored when they have limited social networks and potentially debilitating health conditions (Naughton et al., 2002). This demographic faces challenges in accessing timely assistance during extreme heat events. Researchers have emphasized the importance of social support networks and access to cooling resources in mitigating the impact of high temperatures on heat-susceptible populations, particularly those living alone (Basu & Samet, 2002a).

Lack of access to health care. Additionally, it has been emphasized by researchers that disparities in healthcare

access and quality may limit their ability to receive timely medical care for heat-related illnesses (Basu et al., 2015).

Higher outdoor temperatures in urban areas.

Urban heat island effects can cause higher temperatures for urban populations. These areas have fewer green spaces and more concrete surfaces, which absorb and radiate heat, elevating overall temperatures (Basu & Samet, 2002b). The National Integrated Heat Health Information System provides temperature data comparing disadvantaged versus non-disadvantaged census tracts. Data for South Los Angeles shows that afternoon temperatures in disadvantaged tracts are 2 degrees Fahrenheit warmer compared to non-disadvantaged tracts (www.heat.gov/pages/heat-equity).



Heat.gov serves as the premier source of information regarding heat and health for the nation. This portal seeks to improve federal, state, and local information and capacity to reduce the health, economic, and infrastructural impacts of extreme heat.

Heat.gov is the webportal for the National Integrated Heat Health Information System (NIHIS).

Adaptation To Heat

Many authors agree that there are three levels of adaptive ability: behavioral, psychological, and physiological (Brøgger & de Dear, 1998; Pallubinsky et al., 2023; Rahif et al., 2021). Behavioral adjustments can be personal (e.g., adjusting clothing, activity, posture, eating/drinking cold food or beverages, moving to a different location, etc.), or environmental (e.g., opening/closing windows or shades, turning on fans, etc.). Psychological adaptation recognizes that comfort and acceptability are subjective and depends on a variety of contextual factors, including whether conditions match one's expectations. This, in turn, can be influenced by whether one has personal control over thermal conditions, how constant versus variable one's past thermal experiences are, and whether the indoor climate is controlled entirely by mechanical heating or cooling or if the building is conditioned with passive strategies, making the indoor climate be more aligned with the natural rhythms of the outdoor climate.

The most important physiological adaptations are cardiovascular and sweating. Heat acclimation is characterized by increased perspiration due to the number and distribution of active sweat glands, increased peripheral blood flow, and lowered heart rate, each physiologically favorable outcomes with respect to heat (Syed et al., 2022). Significant beneficial adaptation occurs within the first few days of repeated heat exposure and reaches a

plateau after 7-14 days, varying with the type of exposure (Pallubinsky et al., 2023). Following exposure to heat, the physiological adaptation does not last a long time, reducing after a few days or weeks after a reduction in heat exposure (Lee et al., 2014). In healthy adults, seasonal heat acclimatization is well documented to affect the resting core temperature, resting heart rate, sweat rate, and skin temperature (Brown et al., 2022). In a review, out of 16 studies, 11 studies reported a reduction in core temperature and an increase in sweating rate at the end of the warm season compared to early in the season.

In the context of climate change, there are signs that there may be physiological adaptation to heat occurring in the broad population (Lee et al., 2014). This effect is not well understood and will need more study to better understand the impact across different climates and populations. People living in hotter climates tend to cope better with extreme heat. The maximum temperature threshold associated with increased emergency room visits and admission rates is higher in regions with hotter weather (Kenny et al., 2019). The duration of the exposure is also important; successive days of exposure can lower the threshold for heat-related mortality. The physiological factors affecting heat-related mortality and morbidity include sex, age, and fitness.

Strategies For Avoiding Indoor Overheating

Strategies to avoid indoor overheating and maintain temperatures below the recommended maximum can be categorized into three levels: building, urban, and personal. These strategies are detailed in the following sections. Many of these strategies can and should be used in combination with other strategies.

In this section, the strategies are described functionally and critically assessed. Given the vast array of building design and construction (envelope, interiors, electrical, and mechanical) and the large variations in usage, site conditions, climates, availability of market-ready solutions, electrical panel load capacity, and social and economic issues, there is no one-size-fits-all solution to avoid indoor overheating. The effectiveness of any given solution depends on the specific context.

The following passive and active strategies may only apply to newly constructed residential dwelling units, existing residential dwelling units, or manufactured homes/mobilehomes, or a combination thereof. The method to apply these strategies will likely vary between policy/legislation, incentive programs, building standards, or other vehicles of implementation.

Building Strategies

There are several building-level strategies that can be adopted to mitigate indoor overheating by making buildings more resilient to extreme heat. In this section, two types

of strategies are described: passive and active strategies. Passive strategies include those that control indoor thermal conditions by improving the performance of the building, for example the envelope, without the need for external energy. Since these strategies do not require energy, they are very effective even during power outages for all buildings and occupants, or in situations of energy poverty. In 2010, World Economic Forum defined energy poverty as the lack of access to sustainable modern energy services and products. Therefore, passive strategies can effectively improve the heat resilience of homes in underserved and heat-vulnerable communities (Sun et al., 2021). Active strategies involve using energy to control the indoor thermal environment, such as through mechanical ventilation or cooling. This section discusses the applicability of these strategies to new buildings, existing buildings, and MH.

Passive Strategies

Window ventilation and night cooling. Opening windows to enhance natural ventilation/cooling, potentially in multiple places in a household to enable cross-ventilation (from one side to the other of the home), is an effective strategy to dissipate heat accumulated during the day. Natural ventilation also increases air velocity indoors thereby enhancing convective heat loss from the occupant skin and related evaporative heat losses. Airflow between outdoors and indoors can be wind-driven and/or buoyancy-driven (driven by the difference in outdoor and indoor air

temperature) and it can be enhanced with the use of fans (including whole house fans mentioned below).

Natural ventilation effectiveness depends on building characteristics and the outdoor thermal conditions. If the outdoor temperature is higher than indoors, there is no benefit in increasing air flow from outdoors to indoors. Temperature sensors are affordable and can be installed to inform occupants on when to open and close windows. The lowest temperatures happen at night toward the early morning, and this is usually the best time to have the windows open. Night cooling decreases indoor air temperature during the night hours but also during the day. Thanks to the building's thermal mass and the starting of the day with lower indoor air temperatures. To enable natural ventilation, it is important to provide occupants with easy access to operable windows, vents and skylights. The applicability of night cooling is constrained by several factors that limit its effectiveness and applicability in various contexts. When outside air is polluted (episodically like with wildfires, or frequently as when a window is close to a freeway) it is safer to close the windows and vents and use air filtration (centralized or portable). There could be other limitations to the use of night cooling such as noise pollution, the risk of insect ingress as mosquitoes and security risks related to crime. There is also evidence that nighttime temperatures are increasing more than daytime temperatures, which could reduce the effectiveness of night ventilation in the future.

Window ventilation and night cooling can be applied to new and existing single and multifamily units and MH. Some multifamily layouts, including point access blocks and single-loaded corridors, encourage natural ventilation more than other designs (Eliason, 2021).

Shading to reduce solar heat gain. This strategy aims to reduce heat gain from solar radiation transmitted through transparent parts of the building envelope, for example, windows and skylights. Windows are the primary source of daylight and access to outdoor views thanks to their transparency (Ko et al., 2022). They are fundamental for occupant well-being. However, they also significantly impact indoor overheating, since the incoming solar radiation is also thermal energy, which can raise indoor air temperatures and significantly impact thermal comfort (Arens et al., 2015). This is the reason why windows are usually integrated with shading devices or high-performance glazing technologies that are specifically designed for controlling solar radiation. The most effective ways to control undesired thermal gains from solar radiation while maintaining access to daylight and view are: (i) design and install permanent outside shadings elements as screens, louvers, porches, awnings to block or reflect solar radiation during the warmest hours of the day, thick walls that shade the glass; (ii) design and install dynamic façade technologies, for example, movable shadings as shutters, venetian blinds, and roller shades, which can be adapted either manually or through automated controls to reduce solar gains whilst still ensuring access to the outdoor views. Shading elements are more effective when installed on the exterior and can reduce solar energy from entering the building via the glass. Dynamic shading devices are ideal in one sense because they can adapt to changing indoor or outdoor conditions. This can reduce incoming solar radiation during the warmest hours of the day or the extreme heat periods, while allowing maximum access to daylight and view. However, dynamic shadings or glazing require careful operation and management to avoid undesired performance. This

requires awareness from the occupant on when and how to operate the shading or window technologies most effectively. In situations where occupants cannot frequently operate windows and shadings technology the design and installation of systems that are either automated, so their operation relies on actuators and sensors, or designed to avoid incoming solar radiation in the worst time of the day by using fixed exterior shading elements or glazing with low SHGC (below 0.30). These solutions are more robust to occupant behaviors, and they can ensure effective operation and mitigation of indoor overheating. Selecting windows with low SHGC or adding windows films can substantially reduce cooling loads. Windows films are a low cost and effective solution (Sun et al., 2021) that can be applied to new and existing single and multifamily homes and MH.

Thermal mass. Thermal mass refers to the property of the material and the weight of building components to absorb, store, and release in time thermal energy. This strategy has the overall objective to create a thermal buffer in buildings to shift the heat peak load in time. In this way, the heat during the day is absorbed by the building envelope or structure mass and released later in the night when the outdoor temperature is lower. Thermal mass also has the benefit of reducing the peaks of indoor air temperatures and providing a more stable indoor environment. However, thermal mass effectiveness depends on the operation time of a building or on other strategies that can be implemented in combination, for example, night cooling, to reduce the impact of delayed heat release. In a seismic area like California, increasing the thermal mass of a building, increases the cost of the structural solutions.

There are four main ways heat can be stored in buildings. First, heat can be stored as sensible heat, therefore by

using materials that have high specific heat capacity, for example, concrete floors and foundations. Secondly, heat can be stored by leveraging on latent heat, for example, by using materials that can easily change physical state (from solid to fluid and vice versa) with temperature, for example, phase change materials. Third, heat can be stored by leveraging chemical or thermochemical storage. This latter is especially useful in combination with active systems. Fourth, part of the building can be underground (for example, burrowed into hillside) and the earth play the role of thermal mass. These last three strategies are not commonly used in residential dwelling units. It is difficult to change the thermal mass of a building after construction, so this solution is mainly applicable to new buildings.

Cool coatings and materials. This strategy has the main objective of reflecting unwanted solar radiation, which hits the building envelope thereby increasing the surface temperature and the net heat transfer from outdoors to indoors through the envelope. By doing so, cooling reduction between 2–44 percent, with an average benefit of 20 percent, can be achieved (Levinson & Lee, 2023). Increase in solar reflectance can then mitigate outdoor local overheating by about 0.2 degrees Celsius for each 10 percent increase of albedo (Santamouris et al., 2012). Applying cool coatings on the roof or selecting materials that have retro-reflection (redirecting solar radiation towards the sky) are the best.

One affordable way of increasing the solar reflectance of walls and roofs is by using light colors or white materials that can reach high reflectance levels of 0.7–0.85, in comparison to a typical solar reflectance of 0.04 for traditional black asphalt roofs. A few innovative materials and coatings have also been proposed to limit the undesired effects of cool

coatings: (i) temperature sensitive high solar reflectance coatings, which can change the surface reflectance depending on the outdoor temperature and maintain high solar gains in winter; (ii) incident-dependent or retro-reflective coatings, which reflect the solar reflectance depending on the angle of incidence or redirect the unwanted radiation towards the sky to avoid overheating of pedestrians. Databases with information about the solar reflectance and the infrared emittance of commercial roof products are provided by the EU Project Cool Roofs (<http://coolroofcouncil.eu>), and the US Cool Roof Rating Council (<https://coolroofs.org>).

Sky radiative cooling is the strategy where roof surfaces are cooled down by the thermal exchange with the sky. Particularly during cloudless sky nights, when the sky equivalent temperature is very low, building roofs release heat to the sky through long-wave (thermal infrared) radiation. However, sky radiative cooling can also have detrimental impacts on heating demand, and its effectiveness depends on sky cloud coverage and wind. To enhance sky radiative cooling, the ideal material properties should have a maximum reflectivity in the short-wave range (0.25–2.8 μm) to reflect solar radiation, while the emissivity should be as close as possible to unity in the atmospheric window band (8–13 μm) and zero on the rest of the sky band.

SP-4 Improved building envelopes and ductwork. Improving the insulation level and reducing air leakage in the building envelope and ductwork can reduce heat gain during the day and help reduce indoor temperature. Weatherization programs for existing buildings focus on sealing cracks or holes around doors, windows and pipes; adding insulation to roofs and/or walls; replacing broken, leaky or inefficient windows; and sealing and insulating duct work. Substandard

dwelling units with poor envelopes can benefit considerably from such improvements.

Green walls. Where allowed by building standards, vegetated exterior surfaces can decrease surface temperature, shade from solar radiation and therefore reduce sensible heat gain from outdoors to indoors. The aim of this strategy is to leverage the evaporative cooling potential of greenery, thanks to their moisture content, the shading effect, and the relatively low solar absorption. Green walls and roofs also have a positive impact on outdoor thermal comfort, urban heat islands (Alexandri & Jones, 2008), and rainwater management thanks to their water retention potential. There are two types of vegetated solutions: (i) green walls, where the plants in green façades are rooted in the ground and use the façade as the structure to grow; (ii) living wall/roof systems. In living walls and roofs, the plants are rooted in pots or ground systems integrated into the façade/roof. Overall, vegetated walls require maintenance and irrigation, and typically have higher structural requirements; thus, this solution is very limited in residential buildings and dry climates in California but vines on walls and trellises (green walls) are more commonly used options.

Roof insulation, roof ventilation, and radiant barriers. Roof insulation reduces the heat transfer from the outside to the inside of the building. It is valuable both in summer and winter. Roof ventilation increases thermal dissipation through the roof, air can circulate through these gaps and remove heat through convective heat exchange. The added benefit of ventilated gaps is the control of moisture across the building envelope, preventing the growth of mold. The side effect of ventilated roofs is decreasing thermal resistance in the winter season.

A radiant barrier is a type of reflective building material installed (usually underside of the roof rafters) in the attic to reduce heat transfer between the building and the outside. The sun's radiant heat can penetrate the roof and transfer into the attic space, causing the temperature to rise. A radiant barrier reflects part of the radiant heat back toward the roof, preventing it from entering the attic and reducing the heat gain in the living space below. This helps to keep the interior of the building cooler and can lower cooling costs. Installing a radiant barrier in ceilings can contribute to improved energy efficiency, increased comfort, and potentially lower utility bills. Roof interventions are usually only cost effective in retrofits when coordinated with an end-of-life roof replacement.

Overall recommendation in terms of passive strategies. Initial actions for mitigating overheating risk are: (i) to effectively control solar radiation through shadings, ideally placed outside. Windows with low SHGC and the use of window films is suggested; (ii) to enhance night cooling by effectively opening windows and vents to maximize natural ventilation/cooling when the outdoor temperature is lower than indoor. Natural ventilation can be enhanced with the use of window and ceiling fans. If these actions are not sufficient, secondary actions may consider the retrofit of the building fabric to improve thermal insulation and thermal mass, including the use of cool or green surfaces for roof or walls. Again, these strategies should be considered in the context of building type and if the residential dwelling units are newly constructed or are existing residential dwelling units.

Active Strategies

While passive strategies are important to reduce the risk of indoor overheating and energy demand, they may not be sufficient to protect people under high temperatures, especially the heat-susceptible population. For this reason, it is important to combine or provide access to active cooling strategies in addition to passive strategies when they are not sufficient during extreme heat events. Low-energy or low-carbon active cooling technologies should be preferred to reduce the side effects of indirectly contributing to global greenhouse gas emissions. In addition, the use of active cooling should be limited to situations where thermal conditions are dangerous. Nevertheless, active cooling strategies are only valid for indoor environments when thermal adaptation and other strategies at urban levels are considered for the livability of both indoor and outdoor spaces.

Fans for cooling people. This strategy is mostly recommended because it is cost-effective and can be easily installed and used in residential buildings. Using fans alone or in coordination with air conditioning systems to cool people offers several significant enhancements compared to air conditioning alone, including improved thermal comfort, indoor air quality, air distribution, energy savings, and initial cost savings" (Rafferty et al., 2023).

Whole house fans. When natural ventilation and night cooling alone are not sufficient, it is possible to enhance their effect with windows fans or whole house fans. Whole house fans are usually installed in the attic and move a large amount of air. There should be proper vents/openings that allow air to flow from outside to inside the home, then to the attics and then outside. These fans can be noisy, and

they should be operated with the windows open to avoid creating too much negative pressure (the indoor pressure is lower than the outdoor pressure). They should be operated when outdoor temperatures are equal or lower than indoor air temperatures. Whole house fans cool the building by bringing in cool air and by cooling down the indoor thermal mass. This solution is not applicable when the outdoor conditions are unfavorable (for example, noise and air pollution), similarly to the situations described for "Window ventilation and night cooling". They are cheaper to buy and operate than air conditioning. This solution can be applied to new and existing residential dwelling units.

Evaporative cooling. In evaporative cooling systems also known as evaporative coolers or swamp coolers, the air temperature is reduced by extracting latent heat through the evaporation of water in contact with the air stream. These systems are usually low-cost but require high maintenance (C. Zhang et al., 2021). Since these systems exploit the evaporation of water, evaporative cooling is effective in dry environments, in particular arid climates, where air temperature difference of 27 degrees Fahrenheit (15.0 degrees Celsius) can be achieved (Watt, J., 2012). These cooling systems are usually utilized in open or semi-open spaces, where the growth in absolute humidity levels is mitigated by air movements (E. Erell, D. Peardmutter, Y. Etzion, 2008). In residential buildings they are operated with the windows or vent slightly open to allow the extra supplied air to escape. They are less expensive to buy and operate compared to air conditioners. Some evaporative coolers are portable and can be easily placed near occupants, they can be applied to new and existing single and multifamily homes and MH, in particular the portable units.

Air conditioning. Air conditioning with heat pump systems are an effective and well proven strategy to reduce indoor temperature and humidity. During the twentieth century in the United States, heat-related mortality decreased by about 75 percent thanks to air conditioning, saving an estimated 20,000 lives each year (Barreca et al., 2016). Air conditioning is considered a good strategy for protecting heat-susceptible populations against the adverse effects of extreme weather.

The main negative aspects related to the use of air conditioning are the large energy consumption (and related installation and operation costs) and the associated greenhouse gasses emissions and the strain on the electrical grid. Moreover, air conditioning uses refrigerants that usually have a large Global Warming Potential. Air conditioning strongly relies on electricity and therefore, as a cooling strategy, is very sensitive to power outages. In an older unit, the dwelling's electrical panel needs to have adequate electrical capacity to cover the increased electrical load. When trying this approach for an entire apartment complex, updating the capacity of the local electrical grid may be necessary, which could be extremely costly, or in some cases infeasible depending on the electrical utility provider and possible infrastructure limitations. If air conditioners are coupled with photovoltaic panels and batteries, they could be more resilient to power outages. These air conditioners coupling strategies are important for heat-susceptible populations in sub-standard dwelling units because they would experience higher indoor air temperature during power outages, which could be more frequent during heatwaves or extreme heat events, due to high peaks in energy demand and instability of the electric grid at the same time.

Typical indoor settings between 75-79 degrees Fahrenheit (24-26 degrees Celsius) are considered comfortable in air-conditioned spaces (ASHRAE 55, 2023). Higher temperatures are possible when fans are present.

Radiant cooling. Radiant cooling involves cooling either the floor or ceiling by absorbing heat radiated from the surrounding surfaces using cool water running within pipes or capillary tubes. When applied to the floor, it is named radiant floor cooling, while ceilings are typically cooled using radiant panels in residential settings. Radiant cooling is not very common in California. Humidity and infiltration need to be controlled to avoid surface condensation. In dry climates the problem is less concerning. Radiant systems tend to be more energy efficient than air conditioning systems and the additional thermal mass often allows cooling loads to be shifted to off-peak hours, reducing peak electricity demand. Radiant cooling is primarily in new construction or major retrofits as it can be expensive in retrofit applications.

Ground source cooling. The low and stable temperature of the ground below approximately 30 ft (9 m) can be exploited to release heat in the ground and cool down a working fluid through heat exchangers. In this way, this strategy can remove sensible heat from the indoor environment through heat exchange with a cooler refrigerant, which is usually water (borehole heat exchanger) or air (earth to air heat exchanger). Ground-source cooling is classified as: (i) direct or passive, and (ii) indirect or active. The first system relies exclusively on the thermal exchange between ground and the working fluid, without any additional mechanical cooling. The second system uses the ground temperature as part of a traditional compression refrigeration cycle, where the ground acts as a sink for dissipating heat. Despite ground temperature

is relatively constant, the heat dissipation potential of the ground can be affected by climate change as investigated (G. Chiesa, A. Zajch, 2020). Ground-source cooling is most effective when difference of temperature between working fluid and ground is high, for example, peak load condition (C. Zhang et al., 2021). Ground source heat pumps are not very common in California (Opinion Dynamics, 2022).

Cool rooms. A cool room is a way to provide a safe place in a residential dwelling unit during extreme heat. By focusing on keeping a smaller area cool, it can be less expensive than trying to cool the entire living space and can make it more practical to provide battery backup power. The selected space should be a frequently used space, for example a living room or a bedroom, and it should be easily accessible to all occupants, including people with mobility issues. The same concepts described above may apply, just at a smaller scale.

Again, these strategies should be considered in the context of building type and if the residential dwelling units are proposed for new construction or are existing residential dwelling units.

Personal Scale

The personal scale approaches to keeping cool during hot weather are included here for purposes of including in public education and awareness efforts that could reduce health impacts of heatwaves.

Knowledge, awareness, and information

Education increases people's understanding of risk by improving their knowledge. As the perception of risk increases, adaptive actions increase at both the individual and the societal levels (Kiarisi et al., 2023; Yazar et al., 2022). People's behavior can play a key role in mitigating indoor overheating while reducing energy consumption. For example, simple actions, such as the conscious opening of doors and windows or the use of shading devices (for example, shutters and curtains) can reduce indoor overheating. In addition, other actions, such as adjusting the amount of one's clothing or drinking cold water, can mitigate the impact of overheating on human health. These adaptive behaviors and mitigation strategies are influenced by awareness and knowledge (Van Loenhout & Guha-Sapir, 2016), the general level of education (Pisello et al., 2017), socio-economic status, and household characteristics. Several studies have shown the benefits of increasing awareness and education. For example, training children to adapt drinking habits helps them resist heatwaves and overheating (Kalhoff et al., 2023).

It is key to increase awareness of occupants around: (i) the risk of overheating; and (ii) what actions can be implemented to reduce indoor overheating. This latter includes knowledge of (i) strategies at the individual level, for example, adjusting clothing, drinking water, reducing activity, etc.; (ii) strategies at the household or workplace level, for example, increasing night cooling ventilation and shading. Shading is very effective since it leverages the perceived motivation to pro-actively adapt, leading to increased empowerment of how to better adapt

households to heat (Valois et al., 2020). It has been shown that providing instruction and training through health networks, liaisons, and key people in the community is effective (Kiarisi et al., 2023).

Awareness campaigns and communication activities should be tailored to the specific needs of different audiences. Heat-susceptible populations are targeted due to the severe impact of extreme heat on their health and the disadvantages of communication. This includes the elderly, children, and caregivers (The Lancet, 2015). For example, children need specific communication goals and strategies (Mangus & Canares, 2019). It is important to target a population with either a language barrier or less exposure to information and education (Sheridan, 2007). A recent survey reported that one main source of information during heatwaves is news (Polinkas et al., 2022). The following items provide specific areas that may benefit individuals if presented for awareness:

Adaptive Behavior

Reducing clothing level. Removing or optimizing clothing levels is well established and widely used strategy to reduce the thermal resistance between the body and the environment. This increasing heat losses through evaporation, conduction, radiation, or convection. It is recommended to wear easy-to-modify clothing layers that enable adjusting the level of clothing in time, with loose, light, and breathable fabrics.

Activity and exposure. Limiting activity levels to keep the metabolism and work level low is an effective way to reduce the impact of overheating since it limits the amount of internal heat produced by the body. This strategy is effective both indoors and outdoors. Reducing, eliminating or rescheduling strenuous

activities until the coolest time of the day is recommended.

Breaks in physical activity longer than 5 minutes can lower the body temperature. Selecting cool locations and reducing exposure to solar radiation is also a very effective strategy for limiting the risks of overheating. (Pallinkas et al., 2022).

Drinking cold liquids. The CDC provides the following advice to prevent dehydration: drink more fluids; don't wait until you're thirsty; avoid sugary or alcoholic drinks (these types of beverages can lead to increased fluid loss). Ingestion of cold/icy water increases conductive heat transfer between the warm body and the cool ingested ailments (Jay et al., 2021). If the water is consumed while people are sweating, for example during exercise, its effectiveness is reduced (Jay et al., 2021). Heavy sweating removes salt and minerals from the body that need to be replaced and a sports drink can replace the salt and minerals lost from sweating. Individuals with diabetes, high blood pressure, or other chronic conditions, as well as those on a low-salt diet should consult with a doctor before drinking sports beverages or taking salt tablets.

Self-dousing. Applying water to the skin can reduce physiological heat strain and thermal discomfort and this strategy is very effective when the indoor environment is dry, and clothing does not restrain the evaporation of water directly from the skin (Morris et al., 2019). However, for dousing to be effective needs to be repeated every 5-10 minutes and is therefore not always practical. Similar strategies include immersing hands and forearms in cold water (Giesbrecht, Gordon G., Christopher Jamieson, and Farrell Cahill., 2007); immersing feet above the ankles can increase conductive heat loss and reduce thermal discomfort (DeGroot et al., 2013), even if it has not been proved capable of limiting heat strain. Noticeably, cold water below 41 degrees Fahrenheit (5 degrees Celsius) can also induce local thermal discomfort.

Household modifications. There are affordable and practical actions that can be taken in dwellings to improve the

thermal environment and reduce the risk of overheating: closing windows, curtains, or blinds during the day; opening windows when outdoor temperatures are equal or lower than indoor and solar radiation is not a concern, for example, during the night; limiting the use of appliances that generate heat, such as ovens and stoves (not cooking food), and clothes dryers and select energy; operating fans and small evaporative coolers. In a literature review, clothing adjustment was shown to be the most frequent adaptive behavior across various types of indoor environments followed by fan usage, opening the windows, and the use of air conditioning (Arsad et al., 2023).

Prioritize staying in cooler spaces within the available indoor spaces. Indoor spaces have different temperatures and people should stay in the cooler areas. Spaces that are in proximity of façades, roofs, windows, and higher floors are often warmer than other internal spaces. When possible, it is recommended to avoid using indoor spaces close to roof and façade surfaces in the warmest hours of the day, unless natural ventilation can prevent undesired overheating.

Personal Comfort Systems (PCS) for cooling. PCS is a local device designed to condition the environment in proximity of an occupant according to their personal individual requirements (ASHRAE 55, 2023). Examples of PCS for cooling include fans (small desktop fans, standing fans, ceiling fans) and small misters or evaporative coolers (H. Zhang et al., 2015). Since a PCS only conditions the micro-climate in proximity to the occupant, their energy consumption is generally lower than centralized systems. Use of PCS allows higher air conditioning setpoints without compromising comfort and enable increased individual control.

Alternatives to Traditional Cooling

The following subsections describe the suitability results for each alternative and traditional cooling technology. Unless otherwise noted, the discussion around each technology applies to both single-family and multi-family dwelling units. Suitability was determined based on two factors: climate and cost. Climate suitability for evaporative coolers was based on having at least three hours per day with a wet bulb temperature suitable to allow evaporative coolers to perform effectively.

Ceiling Fans

Ceiling fans are relatively cheap to install and consume much less power compared to a window AC or a central AC system. Ceiling fans are suitable in all climate zones.

In the California residential segments investigated, the main constraints that impact the cost and likelihood of a ceiling fan installation are:

- Ceiling heights
- Installation requirements and challenges
- Power availability at ceiling fan location

The installation of ceiling fans should be at least 7 feet above the floor (with 8'-9" being optimal), 18 inches from the walls, and fan blades at a minimum of 6 inches from the ceiling. Optimal fan performance is achieved when the fan is at least 12 inches from the ceiling. A 7'-8" ceiling height is the minimum ceiling height to install ceiling fan for safety and performance. Many California jurisdictions allow for ceilings as low as 7'-0" in some residential dwelling units. Although rigorous data for dwelling unit ceiling height was not found, it

was estimated that less than 10% of dwelling units have ceiling heights of less than 8 feet.

Structural conditions within ceilings may present an issue as ceiling fan retrofits may require a special hanger or blocking for safe installation. While this does not present a large burden to the cost of installation, it does require the contractor to purchase extra material and take additional time to properly install the fan.

Additionally, if there is not easily accessible power at the desired location of the ceiling fan, this could present a significant cost issue as a contractor would need to install a new branch circuit to the location of the fan. It was assumed that 90% of dwelling units have overhead lighting and power available for ceiling fan installation.

Ceiling fan factors that can affect performance, satisfaction, or comfort include:

- Fan diameter affects airflow and comfort. "Hugger fans" are fans without down rods made for shorter ceilings and can sit closer to the ceiling. However, a distance less than 12" from bottom of blades to ceiling reduces performance.

- Fan vibration can also be an issue for occupants as inexpensive fans tend to use cheaper materials and are not as well-balanced as more expensive fans. Due to the vibration, cheaper fans can also present noise issues.

While addressing these performance, satisfaction, or comfort issues may affect systems in some cases, none generally present significant additional constraints to the suitability of this technology to the residential segments.

Evaporative Coolers

Evaporative coolers reduce air temperature by adding moisture to the air through evaporation. Evaporative coolers are not suitable for marine climate zones as the humidity tends to be too high for the cooler to effectively cool the air. Dry climates where the 1% summer design wet-bulb temperatures are below 70 degrees Fahrenheit are the best climates for evaporative coolers. However, evaporative coolers can provide cooling where coincidental wet-bulb temperatures are as high as 74 degrees Fahrenheit. A UC Davis report found that evaporative coolers are generally not suitable in climate zones 1, 3, 5, 6, 7, 8, and 9. [Davis].

The suitability of three types of evaporative coolers was considered:

- Direct room type evaporative coolers
- Direct type central evaporative coolers
- Indirect type evaporative coolers

Evaporative cooler types vary in terms of cost, performance, and applications for which they are well-suited. All of the evaporative cooler styles require a connection to a waterline. Smaller, portable evaporative coolers that are standalone and do not require a connection to a waterline also exist on the market, but they require continuous occupant maintenance to refill the water reservoir.

A concern with direct type evaporative coolers is the addition of humidity to the space. While this humidity can be mitigated through open windows or a makeup air duct, there is still a risk of elevated humidity in the space. Having an accessible waterline and plumbing it to an evaporative cooler could incur significant cost and therefore make

direct room evaporative coolers unlikely in a multifamily retrofit scenario.

Central evaporative coolers are much more expensive than room evaporative coolers. The cost of the unit, locating and mounting the unit, and associated ductwork required to supply air to the dwelling unit would be too high to make installation likely for either single family or multifamily dwelling units.

Indirect type evaporative coolers tend to not perform as well as direct type evaporative coolers as they circulate indoor air through a heat exchanger where the evaporative cooling takes place. For this reason and the high cost of indirect coolers, it is unlikely that indirect evaporative coolers will be widely used in multifamily or single family residential retrofit applications.

Factors that can affect performance, satisfaction, and comfort include:

- Water use
- High mineral content in local water can increase water use
- Frequent maintenance requires easy access to the unit
- Proper makeup air is required to maintain appropriate humidity levels

While addressing these performance, satisfaction, or comfort issues may affect systems in some cases, none generally present significant additional constraints to the suitability of this technology to the residential segments.

Traditional Cooling Technologies

Central Air Conditioner

Central air conditioners (CAC) work on the principle of direct heat exchange (known as DX) with a refrigerant system. Liquid refrigerant passes through an indoor coil over which a fan blows indoor air. As the air moves over the coil it cools as the refrigerant picks up the heat from the air and boils off into a vapor. That vapor then moves to the outdoor unit where a compressor compresses it thus driving up the temperature and pressure. The outdoor fan rejects the heat from the refrigerant to the atmosphere and the whole process starts over. This is one of the most prevalent cooling systems in California. It is suitable in every climate zone.

A CAC retrofit would likely only occur in systems that have existing ductwork (i.e., a furnace/fan coil system), because retrofitting ductwork into a dwelling unit would add a significant cost. Whether or not the existing ductwork is suitable for CAC would vary by dwelling unit, and undersized existing ductwork could lead to a lack of proper airflow getting to the space it is serving or excessive noise. This holds true for single and multi-family applications.

Another consideration with CAC installation is appropriate clearance around the outdoor unit. Air conditioners require two to three feet of clearance around the unit and 5 feet above. In single family applications this is generally not an issue. In multifamily applications a contractor can generally achieve this using ground space or roof space.

Factors that can affect performance, satisfaction, or comfort include:

- Adequately sized equipment, and efficient and effective distribution design
- Undersized ductwork (possible when re-using existing furnace ductwork) can lead to excessive noise or inefficiency
- Noise and maintenance

Ductless Mini-split Heat Pumps

The cooling mechanism of ductless mini-split air conditioners works on the same DX principle as the CAC. They are suitable in every climate zone. One advantage of heat pumps is that they can provide both heating and cooling.

In the California residential segments investigated, the main installation constraints of ductless mini-splits heat pumps are cost and space constraints for clearance needed to the sides and above the outdoor unit. Generally, two to three feet of clearance around the sides of these units are necessary. This usually presents no problem with single family dwelling units, and a contractor can achieve this by ground or roof space in multi-family dwelling units. However, mini-split air conditioners also require a contractor to run refrigerant lines from the outdoor unit to each indoor unit head, as well as running condensate pumps and drain lines out of the space to the outside, which adds cost.

Factors that can affect performance, satisfaction, or comfort include:

- Concerns about high initial costs and increased operation costs
- Aesthetic concerns
- For heating, decisions about whether to keep or remove an existing furnace.

Window AC

Like central AC and mini-splits, window ACs work on the same DX principle. Window ACs are suitable in every climate zone. In the California residential segments investigated, the main suitability constraints of window ACs are the window type. Window ACs generally require a double hung window. These dwelling units are not suitable for casement windows.

Factors that can affect performance, satisfaction, or comfort include:

- Ability to seal between the unit and the window to prevent leakage
- Noise

Conclusion

After consultation with an extensive group of stakeholders, HCD has concluded that the state should consider a general maximum safe indoor air temperature of 82 degrees Fahrenheit (27.8 degrees Celsius) for residential dwelling units, with different approaches for newly constructed and existing residential dwelling units. This recommendation is grounded in a thorough review of relevant technical information, literature, studies, and state and local standards, and takes into consideration the impact of high indoor air temperatures on human health.

There are unique challenges to enable many existing buildings to be able to maintain a maximum indoor air temperature including infrastructure limitations, technical feasibility, cost of retrofitting, and electrical utility capacity, so this report's recommendations should allow flexibility and encourage incentive based approaches. Newly constructed residential buildings on the other hand, are already very capable of maintaining a safe indoor air temperature, as California energy codes require high performance building envelopes (including windows, doors, and thermal insulation), and the vast majority of new buildings are equipped with air conditioning systems.

The recommended maximum safe indoor air temperature is consistent with applicable research and standards identified herein and a consensus of the participating stakeholders. Factors identified in this document that support the recommended maximum safe indoor air temperature include, but are not limited to, heat and human physiology and effects, critical reference standards, adaptation, related local, state, and international standards; and passive, and active cooling strategies.

Appendix A: Existing U.S. City Code Language

El Paso, Texas. City Code of Ordinances - Title 18 - Chapter 18.10 - 18.10.060

International Residential Code, 2021 Edition, Section R303.8, Required heating, is hereby amended to read as follows: R303.10 Required heating and cooling. Interior spaces intended for human occupancy shall be provided with active or passive space-heating and cooling systems capable of maintaining an indoor air temperature between 68 F (20 C) and 90 F at a point 3 feet above the floor and 2 feet from exterior walls in all habitable spaces. The installation of portable space heaters shall not be used to achieve compliance with this section.

Dallas, Texas. City Code Compliance - Chapter 27 - Section 27-11 (e)

(1) Air Conditioning: an owner shall provide and maintain in operating condition, refrigerated air equipment capable of maintaining a room temperature of at least 15 degrees cooler than the outside temperature, but in no event higher than 85 degrees Fahrenheit in each habitable room.

Clark, Nevada. County Code Compliance - Title 22 - Chapter 22.02 - 22.02.067

All dwelling units, as defined in the International Building Code (IBC) and International Residential Code (IRC), with a permit issuance date for construction or alteration, after February 3, 2019, shall be equipped with active or passive heating/cooling systems.

(A) Dwelling units, except one and two-family dwellings, shall be designed in a manner such that an interior temperature can be maintained between 68 degrees Fahrenheit and 85 degrees Fahrenheit, by the use of active or passive heating or cooling systems. A certificate of compliance certifying that the design meets the requirements of the section and applicable building codes must be sealed and signed by a Nevada Registered Design Professional and submitted to the Clark County Department of Building and Fire Prevention as a part of the permit submittal package.

(a) As used in this section, an active heating/cooling system refers to any heating or cooling system that requires a non-naturally occurring heating or cooling source in order to adjust the temperature in a space.

(b) As used in this section, a passive heating/cooling system refers to any heating or cooling system that does not introduce a non-naturally occurring heating or cooling source in order to adjust the temperature in a space.

Exemptions: Dwelling units that have active heating and cooling systems installed under a permit issued prior to February 3, 2019.

Los Angeles, California. Proposed County Code amendment

The Building Standards Code for unincorporated areas in LA County should be amended to require that residential buildings possess active or passive cooling strategies capable of maintaining temperatures of less than 82 degrees Fahrenheit if there is air conditioning or 86 degrees Fahrenheit if there is evaporative cooling or no cooling unit present. For maximum effectiveness, a new maximum indoor air temperature threshold should apply to new and remodeled residential buildings immediately, with a phase-in for existing construction.

Airizona HB 2146 amends the Arizona Mobile Home Parks Residential Landlord And Tenant Act as follows:

A person who owns or operates a mobilehome park shall not:

Prohibit a tenant from installing reasonably necessary cooling methods to reduce energy costs and prevent heat-related illness and death, including temporary window-mounted ventilation or air conditioning, wall-mounted mini-split air conditioners, commercial window coverings, shutters, window film, shade awnings, skirting or other commercial cooling methods.

Tempe, Arizona. City Code - Chapter 21 - Article II - Division 2 - Section 21-34

(a) General provision. Every rental housing unit should contain safe heating and cooling facilities which are properly installed and maintained in sound condition and capable of providing adequate heating and cooling, appropriate for the climate, to assure a comfortable and healthy living environment.

(c) Cooling requirements. Every rental housing unit shall

have cooling, under the tenant's control, capable of safely cooling all habitable rooms, bathrooms and flush toilet rooms located therein to a temperature no greater than eighty-eight degrees (88°) Fahrenheit, if cooled by evaporative cooling, or eighty-two degrees (82°) Fahrenheit, if cooled by air conditioning. Temperature measurements shall be taken at a distance three (3) feet above floor level in the center of the room. Required cooling shall be provided by permanently installed cooling facilities. Except that those air conditioning facilities serving more than one rental housing unit shall only be required to be designed and operating in conformance with manufacturer's specifications.

Phoenix, Arizona. City Code - Article II § 39-5 (B) (1) (b)

B. Heating, cooling and ventilation systems.

1. Heating, cooling and ventilation systems in any building or structure are to be maintained hazard-free, operational and in a state of good repair. Heating and cooling systems shall be free from hazards associated with ventilation, equipment status, mounting, electrical connections and other potential defects.

b. Cooling requirements. Every rental housing unit where such systems are installed shall have cooling capable of safely cooling all habitable rooms, bathrooms and flushing toilet rooms to a temperature no greater than 86 degrees Fahrenheit, if cooled by evaporative cooling, or 82 degrees Fahrenheit, if cooled by air conditioning. Temperature measurements shall be taken at a distance three feet above the floor in the center of the room. Required cooling shall be provided by permanently installed cooling facilities.

Tucson, Arizona. City Code - Article II - Chapter 16 - Section 16-11 (b)

(2) Cooling. Every dwelling unit, guest room, and congregate residence shall be provided, in all habitable rooms, with either mechanical cooling or an alternate cooling method, to assure a safe living environment. Cooling facilities shall be installed and maintained in a safe condition and in accordance with the manufacturer's recommendations, and shall comply with the following: a. Air conditioners shall be capable of producing ambient temperatures at or below eighty-two (82) degrees. Measurements shall be taken at a distance of three (3) feet above the floor in the center of the room. b. Evaporative coolers shall be capable of producing ambient temperatures below eighty-six (86) degrees. Measurements shall be taken at a distance of three (3) feet above the floor in center of the room. c. Evaporative cooling shall be maintained to be free of excessive rust, corrosion or mineral deposits that limit proper operation. Any mounting apparatus for a cooling facility must be structurally sound. d. Mechanical fans or portable evaporative cooling devices may only be used on a temporary basis as the sole source of cooling when the permanent cooling system is being repaired or replaced.

Houston, Texas. City Code - Chapter 10 - Article IX - Division 4 - Section 10-363 - (d) Utility standards. An owner of property shall:

(8) In each habitable space, if screens are not provided as required in subsection (e)(2) of this section, provide and maintain in good operating condition refrigerated air equipment capable of maintaining a maximum inside temperature 20 degrees Fahrenheit lower than the outside temperature or 80 degrees Fahrenheit, whichever is warmer;

Palm Springs, California. City code - Title 8 - Chapter 8.04 - 8.04.017

2) Add new subsection R303.11, Required air conditioning, to read as follows: R303.11, Required air conditioning, to read as follows: R303.11 Required air conditioning. Every dwelling unit shall be provided with air conditioning facilities capable of maintaining a room temperature of not more than 80 degrees Fahrenheit in all habitable rooms.

New Orleans, Louisiana. City Code - Chapter 26 - Article XIII - Division 1 - Sec. 26-656

(f) Each rental housing unit shall have a cooling system in good working order that can safely maintain a maximum temperature of 80 degrees Fahrenheit in all bedrooms, measured at a point three feet above the floor and two feet from exterior walls.

Portland, Oregon. City Code - Title 27 - Chapter 27.05 - 27.05.021

Amended by Ordinance No. 187432, effective December 4, 2015. Every dwelling unit and guest room shall be provided with heating facilities capable of maintaining a room temperature of 68 degrees Fahrenheit or 20 degrees Celsius at a point 3 feet or 91.44 centimeters above the floor in all of the City of Portland habitable rooms. The version of the Oregon Energy Efficiency Specialty Code adopted by the City in Section 24.10.040 shall regulate the design and construction of the exterior envelopes and selection of heating, ventilating and air conditioning systems and equipment.

A. The annual degree days is 4,792 for heating and is 300 for cooling. The design temperature is 23 degrees Fahrenheit for winter and 85 degrees Fahrenheit for summer.

B. Indoor design temperature shall be 68 degrees Fahrenheit for heating and 78 degrees Fahrenheit for cooling.

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Stakeholder Engagement Report and Recommendations Summary

Maximum Indoor Temperature Threshold Stakeholder Engagement
LA County Department of Public Health

I. INTRODUCTION

In April 2024, the LA County Department of Public Health (DPH) contracted with Estolano Advisors (EA) to conduct engagement with key stakeholders regarding a maximum indoor temperature threshold ordinance for unincorporated LA County. From June - July 2024, DPH and its consultant conducted 10 interviews and facilitated six (6) workgroup meetings with a broad range of stakeholders to collect feedback and recommendations on how to make the policy successful.

This Stakeholder Engagement Report and Recommendations Summary compiles findings from stakeholder engagement, describes takeaways from an accompanying data analysis, and provides recommendations for the County to consider for the draft ordinance. The report contains four sections:

1. **Introduction**, which describes the policy context and the engagement approach;
2. **Data Analysis Findings Summary**, which compiles findings from a residential building analysis for unincorporated LA County;
3. **Engagement Findings Summary**, which analyzes input from stakeholders; and
4. **Recommendations Summary**, which highlights key considerations for the County as it develops the draft ordinance.

A. Policy Background

The Department of Public Health's stakeholder engagement on a maximum indoor temperature threshold is the continuation of a years-long process of research and engagement. In November 2022, the LA County Board of Supervisors passed a motion that directed DPH to work with relevant departments to begin researching maximum indoor temperature thresholds for rental units and priority workplaces.¹ In response to the November 2022 motion, DPH submitted a report to the board that included a recommended maximum indoor temperature threshold of 82 degrees for rental units with active cooling units² and 86 degrees for those with evaporative or no cooling systems.³ In January 2024, the Board of Supervisors voted to continue this work and directed DPH and other relevant departments to (1) gather stakeholder input on how to "equitably establish, define, implement, and enforce" a maximum indoor temperature threshold policy

¹ LA County Board of Supervisors. (2022, November 1). *Investigating Safe Maximum Indoor Temperature Thresholds to Assist Heat Vulnerable Tenants and Workers in High-Risk Workplaces*. <https://file.lacounty.gov/SDSInter/bos/supdocs/174355.pdf>

² Active cooling refers to cooling strategies that require electricity, such as air conditioning units, ceiling fans, and heat pumps. In contrast, passive cooling strategies reduce temperatures without electricity, and include strategies such as cool roofs and pavement.

³ LA County Board of Supervisors. (2023, March 23). *Investigating Safe Maximum Indoor Temperature Thresholds to Assist Heat Vulnerable Tenants and Workers in High-Risk Workplaces* (Item No. 20, Agenda of November 1, 2022). <https://file.lacounty.gov/SDSInter/bos/supdocs/174379.pdf>

for rental units in unincorporated LA County and to (2) prepare a draft ordinance.⁴ The directive does not call for recommendations for workplaces or mobile home units given the varied oversight for these building types. DPH's maximum indoor temperature threshold stakeholder engagement process responds to the 2024 Board Motion's directive and will inform the draft ordinance required in the same motion.

B. Stakeholder Engagement Approach

To meet the directive in the 2024 Board Motion, DPH and its consultant developed a two-phased stakeholder engagement approach to reach a wide range of stakeholders. Engagement consisted of 10 one-on-one interviews (Phase I) and six (6) workshop meetings (Phase II). The goal of this two-phased approach was to engage a smaller subset of experts during Phase I and to use findings from these discussions to inform the larger Phase II conversations. Discussions across both phases of engagement focused on feedback and recommendations for establishing a maximum indoor temperature threshold for rental units in unincorporated LA County.

(a) Guiding Questions

The stakeholder engagement approach aimed to address several key areas of inquiry, which are based on the directives in the 2024 Board Motion:

- Enforcement Considerations: How can the County monitor and ensure compliance? What will enforcement look like?
- Landlord Incentives and Support: What implementation guidance or supports (technical and financial) would enable large landlords (100+units) to comply within one year? What would enable medium and small landlords to comply within three years and five years, respectively?
- Tenant Protections: How can the County prevent, mitigate, or address unintended consequences for tenants?
- Weatherization/Passive Cooling: What can the County do to minimize potential increases in energy use associated with air conditioning, such as by encouraging or facilitating the adoption of passive cooling strategies?
- Temperature Threshold: What are the potential health and quality of life impacts of a maximum indoor temperature threshold of 82 degrees? What is the feasibility of this temperature threshold for the existing building stock?

(b) Engagement Process

The engagement process was designed to reach a broad range of stakeholders, which included: (1) building and energy technical experts, (2) landlords and real estate professionals, (3) legal services providers, (4) tenants' rights groups and community-based organizations (CBOs), (5) tenants, and (6) local jurisdictions with similar policies. DPH developed a large list of stakeholders in these categories, and EA emailed participants on this list to invite them to participate. An overview of each engagement phase is below (see appendix for participant lists and discussion guides).

⁴ LA County Board of Supervisors. (2024, January 23). *Establishing a Safe Maximum Temperature Threshold for Residential Units*. <https://file.lacounty.gov/SDSInter/bos/supdocs/188021.pdf>

- Phase I Interviews: Phase I consisted of 10 one-on-one, 45-minute interviews via Zoom. Given the diverse range of participants, each interview followed a custom set of questions for the relevant stakeholder type. Preliminary findings from these interviews informed the Phase II workshop approach.
- Phase II Workshop Meetings: Phase II consisted of six (6) Zoom workshop meetings to expand on the topics covered during the Phase I interviews and engage a broader audience. Each workshop meeting was limited to 30 attendees to ensure that everyone had a chance to participate. Similar to the Phase I interviews, Phase II meetings followed a custom set of interview questions for each stakeholder type.

C. Summary Report Context

The State of California⁵ and the City of Los Angeles⁶ are considering their own maximum indoor temperature threshold policies in parallel with the County's work on this topic.^{7 8} These policies repeatedly came up during stakeholder engagement. Just prior to the start of engagement, the California Department of Housing and Community Development (HCD) released a draft version of the anticipated Assembly Bill 209 (AB 209) Report, which included recommendations for a maximum indoor temperature threshold for new construction.^{9 10} DPH pointed to this report as additional support for the proposed 82-degree temperature threshold. In many cases, stakeholders also framed their responses to the discussion questions in relation to the report's findings. Similarly, stakeholders often pointed to the City of LA's ongoing research on an indoor cooling apparatus requirement to support their positions on the County's proposed policy. Comments from stakeholders on both policies are included throughout the stakeholder findings for context.

II. ANALYSIS OF RESIDENTIAL BUILDINGS IN LA COUNTY

To supplement stakeholder input, the consultant team analyzed residential buildings in unincorporated LA County based on building type and age. Findings from this analysis provide the County with a baseline understanding of the residential building context, including the number of older buildings—given that these buildings may need more retrofits to comply with this policy—and the geographic distribution of these buildings.

⁵ Assembly Bill 209 (AB 209) requires HCD to convene relevant stakeholders and develop recommendations for a maximum indoor temperature threshold for rental units in the state by January 1, 2025.

⁶ In April 2023, the City of Los Angeles City Council passed a motion directing: (1) the Los Angeles Housing Department to identify code sections that could be amended to reflect an indoor cooling requirement for rental units, and (2) the Department of Water and Power and other departments to report on existing and potential utility subsidies for low-income tenants.

⁷ City of Los Angeles. (2023). *Official Action of the Los Angeles City Council No. 23-0453*. https://clicrep.lacity.org/online/docs/2023/23-0453_cat_05-31-23.pdf

⁸ California Department of Housing and Community Development. (2024). *Plans & Reports – Maximum Safe Indoor Air Temperature Policy Recommendation (AB 209, Chapter 251, Statutes of 2022)*. <https://www.hcd.ca.gov/policy-and-research/plans-and-reports>

⁹ *Ibid.*

¹⁰ The draft report recommended that the state consider: (1) requiring a maximum indoor temperature threshold of 82 degrees for new rental units, (2) enabling a lower temperature threshold of 79 degrees for new rental units that house high-risk populations, and (3) allowing for variation in the maximum temperature threshold when there is air movement or humidity present.

More specifically, the data analysis includes an examination of the following metrics:

1. Residential Building Type
2. Residential Building Age (for All Residential Buildings and Multi-family Buildings)

This section provides (1) an overview of the analysis methodology, (2) a discussion of the approach limitations, and (3) a summary of findings.

A. Methodology

The consultant team analyzed metrics for residential buildings in unincorporated LA County. The main data source for the analysis is the parcel data from the LA County Office of the Assessor (2006 - 2023). In addition, the consultant team pulled census tract data from the United States Census Bureau (2022), as well as supervisorial district data (2024) and census-designated places data (2020) from the LA County Planning Office.

The consultant team filtered the parcel data for: (1) parcels in the most recent annual assessment (2023),¹¹ (2) parcels in unincorporated LA County, (3) non-vacant parcels,¹² and (4) residential use parcels.¹³ The consultant team further removed parcels that are located in an incorporated area but were designated as unincorporated and parcels for which the data did not have a longitude or latitude. This segmentation of the data resulted in a dataset that is filtered to only include parcels in unincorporated LA County with a residential building on their premises.

To analyze the findings, the consultant team referenced the Southern California Association of Governments' (SCAG) 2021 Local Housing Data for Unincorporated LA County. Building types and year intervals align with those in SCAG's report to facilitate comparisons with previous data analyses.

B. Limitations

This section summarizes the limitations of this residential building analysis for unincorporated LA County:

- (a) **Building Ownership:** Building ownership information can help shape the County's understanding of rental units as a subset of single-family and multi-family buildings. The dataset provided through the Assessor's office did not include information on ownership. This limitation restricted the consultant team's ability to segment the data based on ownership type, and thus, the analysis does not distinguish between rental and owner-occupied buildings.
- (b) **Section 8 Vouchers:** While Section 8 vouchers play a critical role in promoting housing affordability, Section 8 voucher data is not readily accessible at the sub-

¹¹ The consultant team used parcel data to analyze characteristics of the residential buildings on these parcels. In some cases, parcels may contain multiple buildings; however, the analysis did not distinguish between parcels with one or more buildings.
¹² Vacant parcels were determined based on the Assessor's data designation of Use Code Description for vacant parcels as "vacant" and Year Built for vacant parcels as "0."
¹³ The Assessor's data distinguishes between three Use Codes for building types: Residential, Commercial, and Industrial. As a result, the analysis does not include mixed-use buildings that may fall outside of the Residential designation.

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county level. As a result, the analysis does not include data on the quantity or geographic distribution of Section 8 vouchers in the county.

(c) Data Analysis Scope: This analysis was limited in scope and does not touch on additional metrics that may be relevant for the County's policy development efforts. Additional metrics may include (1) application of this analysis to rental dwellings to understand the age and geographic distribution of rental units; (2) the intersection between extreme heat and building age to understand the urgency of upgrades in older buildings; or (3) the number and distribution of air conditioning units at the sub-county level to understand the need for active cooling across the county. These metrics, in addition to the studies requested by stakeholders in the next section, could be productive areas of study for the County to consider.

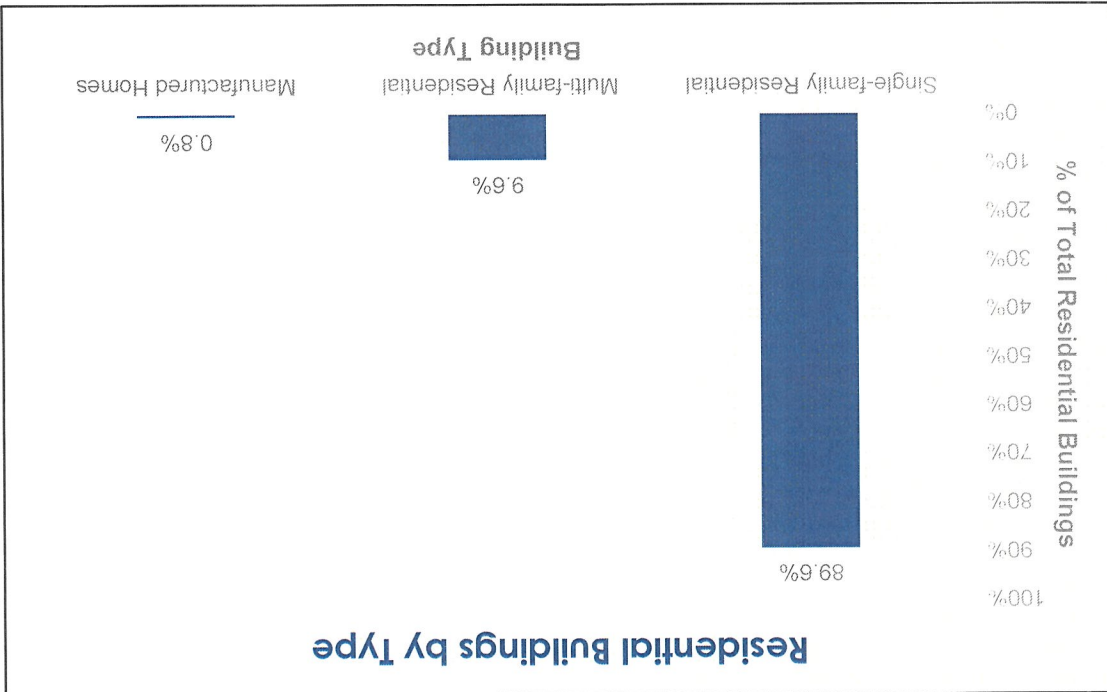
C. Summary of Findings

This section summarizes the analysis findings, which fall into two main topics: (1) Building Type, and (2) Building Age.

(a) Building Type

The building type analysis identified the prevalence of single-family buildings, multi-family buildings, and manufactured homes in unincorporated LA County as of 2023.¹⁴ The consultant team split the residential building data into single-family residential, multi-family residential, and manufactured homes. Figure 1 summarizes the number of residential buildings in each category. Most residential buildings in unincorporated LA County are single-family (90%). Only 10% of residential buildings are multi-family. Only one percent (1%) of residential buildings are manufactured homes.

Figure 1: Residential Buildings by Type.



Data source: Office of LA County Assessor.

(b) Building Age

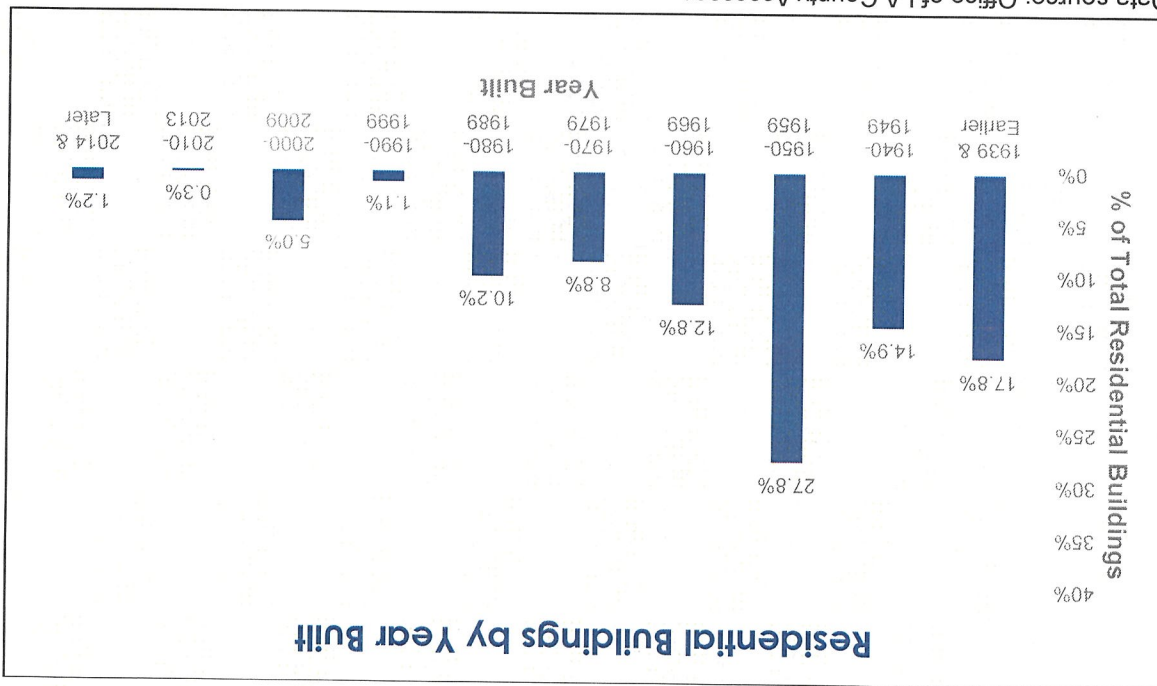
The building age analysis looked at (1) residential buildings overall and (2) multi-family buildings in particular. This section describes findings within each of these topics.

¹⁴ Manufactured homes are factory-built homes that are transported to a piece of land. Mobile homes refer to manufactured homes produced before 1976. U.S. Department of Housing and Urban Development (HUD). (n.d.). *Manufactured housing and standards-Frequently Asked Questions*. https://www.hud.gov/program_offices/housing/mhs/faqs

Residential Buildings

The building age analysis identified the number of current residential buildings built in each decade since 1940, with an additional category for buildings built in 1939 or earlier. A significant portion of residential buildings in unincorporated LA County date back to 1959 or earlier (61%) (Figure 2). More specifically, a plurality of buildings were constructed in the 1950s (28%), and the second highest share was built in 1939 or earlier (18%). Less than 10% of residential buildings were built between 2000 and 2023 (7%).

Figure 2. Residential Buildings by Year Built.

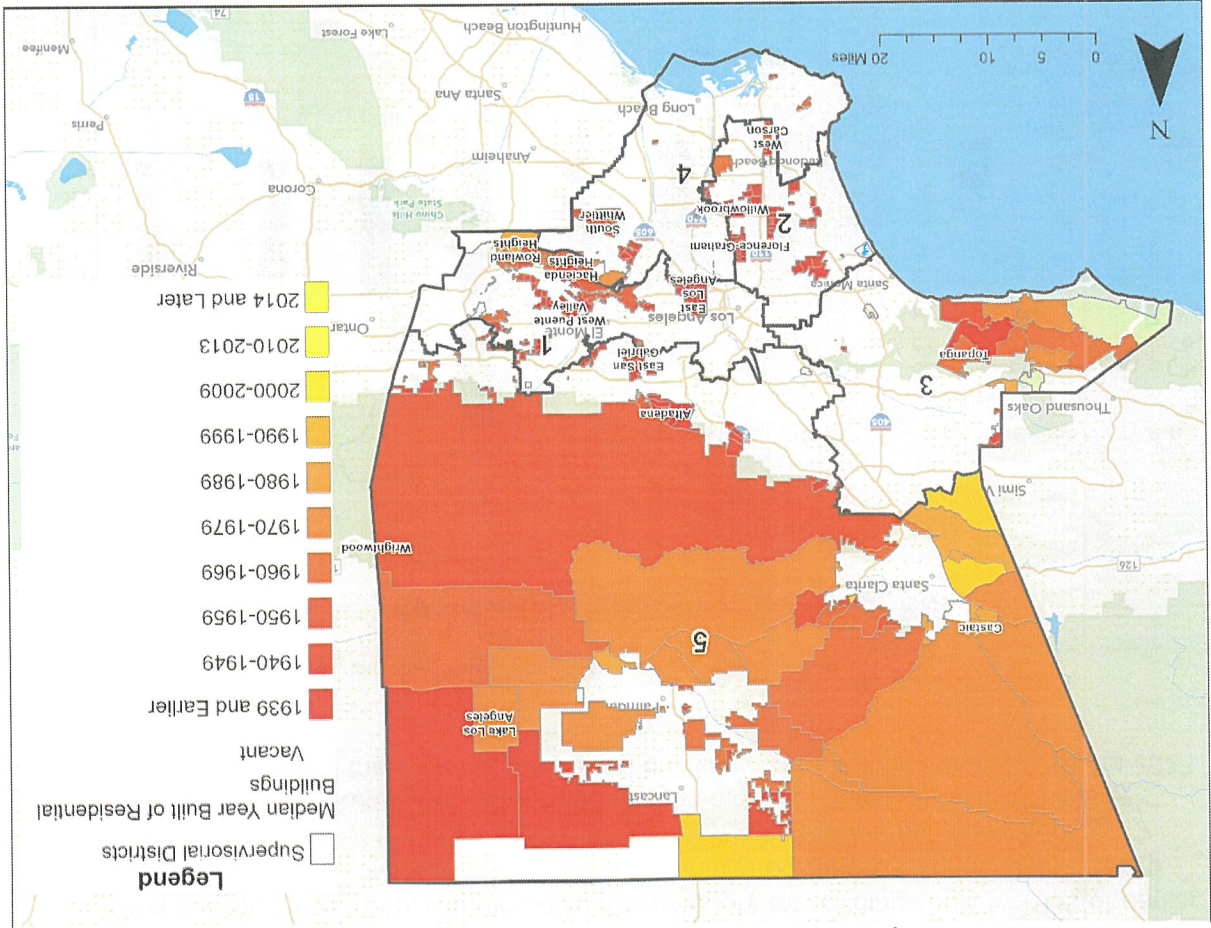


Data source: Office of LA County Assessor.

The consultant team analyzed the data spatially to determine any trends in residential building age at the census tract level. Census tracts with the oldest residential buildings¹⁵ are predominantly located in and around Altadena, East Los Angeles, - Florence-Graham, and northeast of Lake Los Angeles (Figure 3). Conversely, census tracts with the newest residential buildings are located in and around Castaic, Rosamond, Stevenson Ranch, Topanga, and small pockets near Hacienda Heights and Rowland Heights. The spatial distribution of residential buildings among LA County's five Supervisorial Districts demonstrates that there are buildings from the 1940s and earlier within each of the districts (Figure 3); however, census tracts in Districts One (1) and Two (2) tend to have an older median building age than those in other districts.

¹⁵ The consultant team used the median building age across each census tract to determine these trends.

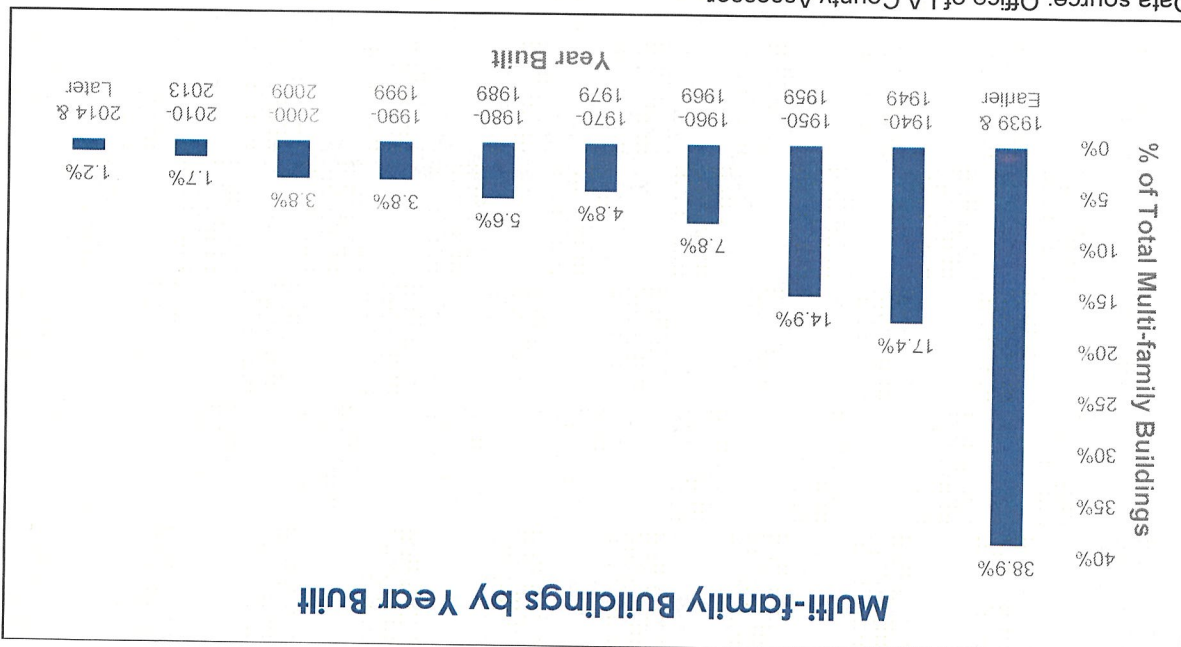
Figure 3: Heat Map of Median Year Built for Residential Buildings in Unincorporated LA County, by Census Tract and LA County Supervisorial District.



Multi-family Residential Buildings

The consultant team further segmented the analysis by considering the age of multi-family buildings as a subset of residential buildings (Figure 4). This analysis demonstrates that there is a higher proportion of multi-family buildings built in 1959 or earlier (71%) than that for residential buildings overall (61%). More specifically, the share of multi-family buildings built in 1939 or earlier (39%) is more than double that for all residential buildings (18%), while the share of multi-family buildings built in the 1950s (15%) is just over half that for residential buildings as a whole (28%). More recently, the proportion of multi-family buildings built between 2014 and 2023 (1.2%) is the same as that for residential buildings overall.

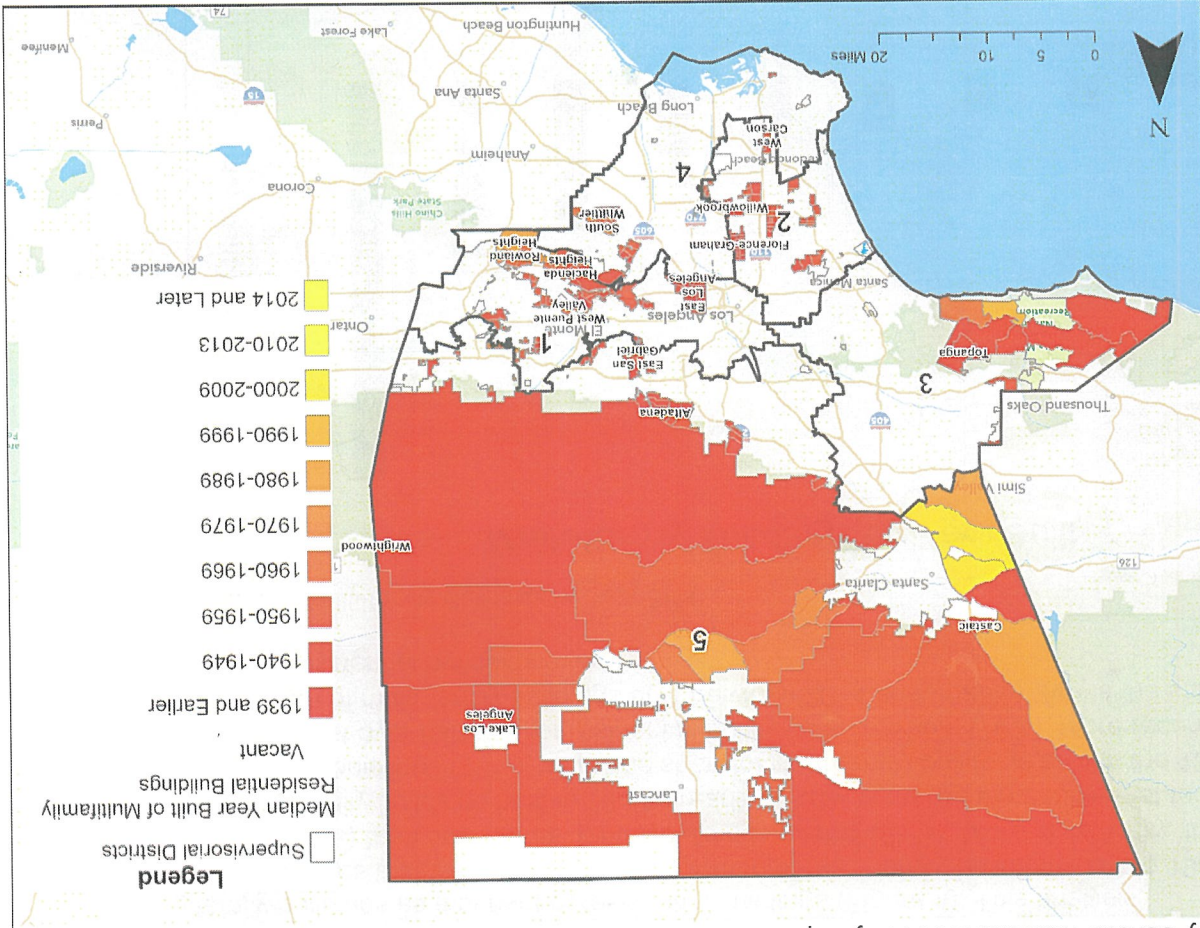
Figure 4. Multi-family Buildings by Year Built.



Data source: Office of LA County Assessor.

When analyzed spatially, the median building age for multi-family buildings tends to be older in many census tracts than that for residential buildings overall (Figure 5). More specifically, census tracts in and around East San Gabriel, Topanga, West Whittier-Los Nietos, and Wrightwood have a noticeably older median building age for multi-family buildings than they do for residential buildings overall. However, census tracts in and around Castaic are one of the few census tracts with a lower median building age for multi-family buildings than for residential buildings overall. The distribution of multi-family buildings among LA County's five Supervisorial Districts also resembles that for residential buildings; however, Districts Three (3) and Five (5) have more census tracts with an older median building age for multi-family buildings than for residential buildings overall (Figure 5).

Figure 5: Heat Map of Median Year Built for Multi-family Buildings in Unincorporated LA County, by Census Tract and LA County Supervisorial District.



Data sources: Office of LA County Assessor, LA County Planning, United States Census Bureau.

III. ENGAGEMENT FINDINGS

To inform this report's recommendations, DPH and its consultant hosted interviews and workshop sessions to gather actionable feedback and suggestions for the development of a maximum indoor temperature threshold in unincorporated LA County. This section categorizes the qualitative feedback from stakeholders into the following themes: (1) policy considerations, (2) resources and support, (3) climate resilience and infrastructure, and (4) collaboration with other policy efforts.

A. Policy Considerations

Participants shared several policy elements for the County to consider when drafting the maximum indoor temperature threshold ordinance, including considerations for (a) the temperature threshold, (b) tenant protections, (c) phased implementation, (d) enforcement, and (e) applicability to mobile homes. This section describes takeaways within each of these themes.

(a) Temperature Threshold Considerations

Research and data need to undergird the County's proposed maximum indoor temperature threshold. DPH shared with participants that the state's AB 209 report helped inform the County's proposed maximum indoor temperature threshold of 82 degrees. While many participants were familiar with the AB 209 report's temperature threshold recommendations, they still had concerns about the data that served as a basis for the County's proposed temperature threshold. Particularly, participants were concerned that the state report focused on new construction and questioned how this temperature threshold would work for older buildings. Building and energy technical experts and landlords emphasized that older buildings may experience more challenges in reaching certain temperature thresholds given that they will likely need more extensive weatherization retrofits.^{16 17} Additionally, CBO participants acknowledged that though the proposed 82-degree threshold aligns with the state's report, it was not clear how an 82-degree maximum would impact public health.¹⁸ They were interested in seeing data on how vulnerable groups would fare in 82-degree environments, given the state's emphasis on a 79-degree threshold for these groups. Participants agreed that the County should provide robust research that informs their reasoning for the temperature threshold and share how this temperature will impact vulnerable populations and apply to the older housing stock.

Some participants suggested that the County set a lower temperature threshold of 79 degrees (or lower) across the region to support high-risk populations. Participants noted that high-risk populations including older adults, people with disabilities, pregnant women, children, and people with chronic illnesses are particularly

¹⁶ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹⁷ Workgroups: Landlords Large Group Meeting (July 25, 2024)
¹⁸ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)

vulnerable to the health effects of heat exposure.^{19 20} For this reason, some participants advocated for a lower temperature threshold, indicating that 82 degrees may still pose health risks to vulnerable populations, which would be hard to identify in the county. Some CBOs and legal services providers suggested that the County consider a 79-degree threshold, which would align with the state's AB 209 recommendation for high-risk populations, while other CBOs and some tenants expressed concerns that 79 degrees might still be too hot for these populations.^{21 22 23} One interviewee emphasized that sleep quality and learning outcomes can be negatively affected by temperatures below 82 degrees, so the County will need to consider its goals with this policy and whether it aims to address these day-to-day impacts.²⁴ Many CBOs encouraged LA County to be a leader in this area by setting an even lower maximum temperature threshold than other jurisdictions to prioritize vulnerable populations and address heat burden, especially for low-income communities.²⁵

Extreme heat in LA County varies widely, and the County will need to prioritize areas that are most vulnerable to heat. Several participants noted that temperatures vary widely across the region and urged the County to take a nuanced approach to the policy that considers these geographic differences. Landlord participants pointed out that residents in the San Gabriel Valley experience much higher temperatures than residents who live along the coast, and that coastal areas should therefore, be exempt from the policy due to the lower temperatures there.²⁶ Building and energy technical experts agreed that the county's climate zones are diverse but suggested that the county utilize these differences to develop an approach that focuses attention on the most vulnerable areas.²⁷ They suggested that the County use its Climate Vulnerability Assessment to identify the most heat vulnerable areas and prioritize communities most vulnerable to extreme heat for early policy adoption. These participants encouraged the County to consider these strategies to better address the geographic differences across LA County and to prioritize areas that are most vulnerable to extreme heat.

(b) Tenant Protections

Participants highlighted the importance of preventing unintended consequences from this policy, such as rising household costs or evictions. CBOs, legal services providers, and tenants urged the County to identify measures that would ensure that tenants are not subject to increased housing costs or evictions due to the policy. These participants worried that landlords may interpret policy compliance as a "substantial remodel," and therefore a just cause for eviction.^{28 29 30} They also worried that retrofit costs would be passed down to tenants, resulting in higher rents. Further, participants

¹⁹ *Ibid.*

²⁰ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.

²¹ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)

²² Workgroups: Legal Service Providers Group Meeting (July 24, 2024)

²³ Workgroups: Tenants Large Group Meeting (July 30, 2024).

²⁴ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.

²⁵ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)

²⁶ Workgroups: Landlords Large Group Meeting (July 25, 2024)

²⁷ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)

²⁸ Workgroups: Legal Service Providers Group Meeting (July 24, 2024)

²⁹ Workgroups: Tenants Large Group Meeting (July 30, 2024)

³⁰ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)

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encouraged the County to ensure that cooling-related unit modifications would not be grounds for eviction,^{31 32} while one participant emphasized the challenges with allowing tenants to install their own cooling units given the potential for improperly installed units to become fire hazards.³³

Participants suggested that the County look to the City of LA's Decarbonization Policy, which includes rent caps and removes substantial remodeling as a just cause for eviction.^{34 35} They also shared strategies that the County can consider to mitigate the impacts of passthrough costs on tenants.^{36 37} Under the County's RSTPO, landlords cannot pass more than 50% of improvement costs to tenants.³⁸ One CBO suggested that the County consider integrating cooling requirements in the Health and Safety Code, so that upgrade costs are not considered capital costs and therefore landlords cannot pass any portion of them to tenants.³⁹ This participant also shared about the City of LA's decarbonization cost-recovery program which capped passthrough costs at \$35 for upgrades related to this policy. Low-income and vulnerable tenants could receive waivers for pass-through costs if implemented, as one legal services provider suggested.⁴⁰ Lastly, one CBO mentioned that the State of Washington's Sustainable Energy Trust Loan Program offers loans to landlords to cover energy efficient upgrades, provided that they do not increase rents beyond a certain percent in the first six years.^{41 42} The County will need to consider a variety of strategies to proactively mitigate additional burdens for tenants.

Landlords disagreed with prohibiting passthrough costs for tenants, sharing concerns about their ability to recoup costs from this policy without dedicated fees. Market-rate landlords shared that policies such as LA County's COVID-19 Tenant Protections Resolution and the rent caps set by the RSTPO, have limited the income they receive from rent and therefore strained their financial ability to maintain their buildings.^{43 44 45} Recent policies requiring retrofits or upgrades to residential buildings, such as the City of Los Angeles Seismic Retrofit Ordinance and Senate Bill 721, which requires repairs to balconies and other elevated elements in an apartment building,⁴⁶ have further financially strained landlords, especially "mom-and-pop" owners.⁴⁷ Landlords worried that with the inability to pass costs to tenants, they will not be able to

³¹ *Ibid.*
³² Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.
³³ *Ibid.*
³⁴ Friedman, I. and Walker, O. (June 18, 2024). Interviewed by Estolano Advisors.
³⁵ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
³⁶ Workgroups: Tenants Large Group Meeting (July 30, 2024)
³⁷ Workgroups: Tenants Rights Groups/CBOs Large Group Meeting (July 22, 2024)
³⁸ County of Los Angeles. (2019). *Rent Stabilization and Tenants' Protections Ordinance, Pass-Through Cost Recovery for Fully Covered Rental Units Code 8.52.070*.
³⁹ https://library.municode.com/calos_angeles_county/codes/code_of_ordinances?nodeId=TT8COPRBUWARE_DIV3HO_CH8.52RE
⁴⁰ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
⁴¹ Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.
⁴² Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
⁴³ WSHFC. (n.d.). *Energy Financing Programs*. <https://wshfc.org/energy/> (accessed August 15, 2024).
⁴⁴ Workgroups: Landlords Large Group Meeting (July 25, 2024)
⁴⁵ Gagnon, J. (June 11, 2024). Interviewed by Estolano Advisors.
⁴⁶ O'Neill, T.; Rhodes, M.; and Wright, J. (August 12, 2024). Interviewed by Estolano Advisors.
⁴⁷ WJE Advisory. (2019, February). *Summary of California Senate Bill No. 721*. <https://www.wje.com/assets/media/files/wje-advisory-california-senate-bill-721.pdf>
⁴⁷ Workgroups: Landlords Large Group Meeting (July 25, 2024)

cover the costs of improvements, especially for older buildings that will need extensive upgrades.^{48 49 50} For these reasons, landlords said they would be adamantly against a policy that prohibits passthrough costs to tenants and emphasized that upgrades to comply with the policy would be financially infeasible without associated renter payments.

(c) Phased Implementation Considerations

The County's older building stock will likely require substantial retrofits to adopt this policy and should have more time to do so, but CBOs emphasized that these challenges should not exempt older buildings from complying. Building and energy technical experts and one landlord interviewee agreed that new construction will be easier to adapt to the policy, making implementation for new buildings more readily feasible.^{51 52} In contrast, older buildings will need more extensive retrofits and may uncover a need for lead or asbestos remediation, thus requiring more time for implementation.^{53 54 55} While some landlords agreed that phased implementation—starting with new construction and providing more time for older buildings—would be appropriate, they emphasized that funding will be key to ensure that owners of older buildings are able to meet the policy requirements and timeline.^{56 57} Others urged the County to exempt older buildings from this policy given the implementation challenges.^{58 59} Building and energy technical experts and affordable housing representatives also emphasized the need for affordable housing operators to have more time to comply given their unique resource constraints.^{60 61}

Despite landlords' desire for a phased approach or an exemption for older buildings, CBOs wanted to ensure that older buildings are not left behind. They noted that low-income tenants typically live in older buildings as they are more likely to be affordable, and they urged the County to include older buildings in the policy to support these households.⁶² While many participants supported an implementation timeline that considers the diverse building stock in the county and allocates more time for older buildings to comply, the County will need to consider how best to support owners of older buildings to ensure they have the tools and financial resources necessary for successful implementation.

⁴⁸ *Ibid.*
⁴⁹ Gagnon, J. (June 11, 2024). Interviewed by Estolano Advisors.
⁵⁰ O'Neill, T.; Rhodes, M.; and Wright, J. (August 12, 2024). Interviewed by Estolano Advisors.
⁵¹ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
⁵² Gagnon, J. (June 11, 2024). Interviewed by Estolano Advisors.
⁵³ *Ibid.*
⁵⁴ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
⁵⁵ Workgroups: Landlords Large Group Meeting (July 25, 2024)
⁵⁶ *Ibid.*
⁵⁷ Gagnon, J. (June 11, 2024). Interviewed by Estolano Advisors.
⁵⁸ Workgroups: Landlords Large Group Meeting (July 25, 2024)
⁵⁹ O'Neill, T.; Rhodes, M.; and Wright, J. (August 12, 2024). Interviewed by Estolano Advisors.
⁶⁰ Workgroups: Landlords Large Group Meeting (July 25, 2024)
⁶¹ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
⁶² Workgroups: Tenants Rights Groups/CBOs Large Group Meeting (July 22, 2024)

(d) Enforcement

This policy should conduct proactive inspections for enforcement and should be part of the County's existing housing programs to streamline enforcement requirements. Participants noted that inspections would support enforcement to ensure that units adhere to the temperature threshold. For example, the City of Dallas conducts proactive inspections to evaluate and score dwelling units every three years.⁶³ During inspections, staff also educate landlords and answer any questions on requirements. If landlords are not in compliance, the City issues a citation. To avoid creating an additional round of inspections for this policy, CBOs and legal services providers suggested integrating this policy's enforcement into existing County programs. Particularly, many wanted the County to integrate this policy in the new Rental Housing Habitability Program (RHP) and designate extreme heat as a health and safety or habitability issue.^{64 65 66} Under the RHP, the County conducts proactive inspections of rental units in unincorporated LA County every four years, with associated fines and incentives, to ensure that housing stock remains habitable and safe.⁶⁷ As part of this, these participants wanted the County to dedicate enough staff to properly enforce the policy via inspections.^{68 69}

Tenants will need an accessible system for reporting landlord non-compliance and will need support with navigating this new system. CBOs noted that a crucial element of enforcement will be providing a system where tenants can report non-compliance with the policy. For the system to be effective, CBOs stressed that it will need to be easily accessible, available in multiple languages, and transparent about how the issue will be addressed.⁷⁰ For example, CBOs shared that the online form to file a complaint for a violation of the County's Comfort Heat policy, which requires a minimum indoor temperature of 70 degrees, does not provide clear next steps for following up on enforcement.⁷¹ Participants urged the County to improve on form-based compliance systems to deploy a more accessible and transparent approach for filing complaints. They emphasized that CBOs can be a critical component of this approach. Many tenants with limited access to the internet or technology will need technical assistance to learn how to navigate and utilize this new reporting system.⁷² To facilitate this technical assistance, the County may consider exploring partnership opportunities with CBOs that have experience providing tenant assistance to further promote accessibility and transparency in reporting.

⁶³ Garcia, A.; Savic, R.; and Secoundata, C. (June 20, 2024). Interviewed by Estolano Advisors.
⁶⁴ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
⁶⁵ Workgroups: Legal Service Providers Group Meeting (July 24, 2024)
⁶⁶ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
⁶⁷ Los Angeles County Department of Public Health. (n.d.). *New Rental Housing Habitability Program: Los Angeles County Department of Public Health - Environmental Health*. <http://www.publichealth.lacounty.gov/eh/about/rental-housing-habitability-program.htm>
⁶⁸ Workgroups: Legal Service Providers Group Meeting (July 24, 2024)
⁶⁹ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
⁷⁰ *Ibid.*
⁷¹ County of Los Angeles (n.d.). Code of Ordinances: Health and Safety Code 11.20.470. <http://lacounty.ca.gov/codes/ordinances/law1120470>
⁷² Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting

(e) Consideration for Mobile Homes

Many participants urged the County to include mobile homes in the policy, given that this housing type is vulnerable to many of the same heat extremes as rental units. Participants, including CBOs and legal services providers, emphasized the importance of including mobile homes in a maximum indoor temperature threshold policy. While some CBOs understood that the County may not have authority to regulate construction upgrades in mobile homes, they suggested that the County conduct additional legal analyses to identify opportunities for local jurisdictions to provide this oversight.⁷³ Participants bolstered their support for including mobile homes by noting that this housing type often faces similar challenges to rental units and that the County already has mobile home renter protections in place under the RSTPO.^{74 75 76} One interviewee added that many mobile home parks do not allow air conditioning upgrades, despite the fact that mobile homes are especially vulnerable to extreme indoor heat because of limited insulation and cooling.^{77 78} These limitations make this population particularly vulnerable to extreme heat. Therefore, these participants urged the County to reconsider how to address extreme heat in mobile homes as part of this policy.

B. Resources and Support

Participants identified numerous types of supports that landlords and tenants will need for this policy to be successful. These resources include: (a) technical assistance and funding support for landlords, and (b) technical assistance and funding support for tenants. This section describes takeaways within each of these themes.

(a) Technical Assistance and Funding Support for Landlords

Landlords were concerned about covering and recouping the costs of building retrofits and emphasized the need for rebates or other financial assistance. Landlords shared that their primary concern with this policy is the cost of retrofitting their buildings to accommodate a maximum indoor temperature threshold. Landlords strongly emphasized the need for the County to provide financial assistance through direct rebates or subsidies or a pool of resources to address these costs.^{79 80 81} They also expressed frustration with subsidies that local governments have promised in the past and not delivered, citing the Los Angeles Seismic Retrofit Ordinance's Property Assessed Clean Energy Program as one such example, and they are concerned that they will have to invest significant funds into retrofits without any support from the County.⁸² Participants also raised the specific challenges affordable housing operators

⁷³ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
⁷⁴ Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.
⁷⁵ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
⁷⁶ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.
⁷⁷ Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.
⁷⁸ UCLA Luskin Center for Innovation. (2022, July). *Protecting Californians with Heat-Resilient Homes*. <https://innovation.luskin.ucla.edu/wp-content/uploads/2022/07/Protecting-Californians-with-Heat-Resilient-Homes.pdf> (accessed August 15, 2024).
⁷⁹ O'Neill, T.; Rhodes, M.; and Wright, J. (August 12, 2024). Interviewed by Estolano Advisors.
⁸⁰ Gagnon, J. (June 11, 2024). Interviewed by Estolano Advisors.
⁸¹ Workgroups: Landlords Large Group Meeting (July 25, 2024)
⁸² *Ibid.*

face due to their tighter profit margins, which make it harder for these operators to fund retrofit costs.⁸³ Therefore, both market-rate and affordable housing landlords emphasized that financial support will be critical for the feasibility and success of this policy.

Participants pointed to existing rebate programs that should be leveraged or expanded to support landlords with addressing retrofit costs as a result of this policy. Building and energy technical experts and a legal services provider cited existing programs such as the California Energy Commission's Equitable Building Decarbonization Program's Direct Install Program and the state's Low-Income Weatherization Program.^{84 85} These programs provide low- to no-cost retrofits and incentives for landlords or tenants to promote the adoption of low-carbon and energy-efficient technologies in low-income communities.^{86 87} Although these participants cited these programs as successful models, they also noted that the limited resources that the state allocates to these programs tend to be depleted quickly because of their popularity and that the recent state budget cuts reduced their funding.^{88 89} This poses a challenge for landlords because these programs can be competitive or inaccessible due to their high demand and limited resources. To address this challenge, these participants suggested that the County adopt a program similar to the Equitable Building Decarbonization Program to directly support with retrofits in LA County or that the County collaborate with SoCal Edison to expand the energy efficiency and weatherization rebates and subsidies available.

Landlords identified a need for technical assistance and education to understand the policy's requirements, identify funding available, and navigate building retrofits needed. Both market-rate and affordable housing landlords expressed the need for technical assistance to help them navigate policy implementation.⁹⁰ Technical assistance can help ensure that landlords understand the policy, including when the policy will be in effect, what will be required, and how to comply. Because of their unique regulations, affordable housing operators also expressed a need for technical assistance tailored to their specific needs. Alongside technical assistance, the County could also provide educational presentations to major landlord groups in the area. When rolling out a similar policy in Dallas, City staff met with and presented to various landlord groups and apartment associations regarding the policy.⁹¹ The City accompanied this approach with a robust marketing campaign on the policy, which included brochures, social media posts, and media releases. The County can take a similar, multi-pronged technical assistance and education approach to reach the many landlord and real estate associations across the county.

⁸³ *Ibid.*

⁸⁴ Workgroups: Building and Energy Technical Experts Large Group Meeting (July 29, 2024)

⁸⁵ Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.

⁸⁶ California Energy Commission. (n.d.). *Equitable Building Decarbonization Program*. <https://www.energy.ca.gov/programs-and-topics/programs/equitable-building-decarbonization-program>

⁸⁷ California Department of Community Services and Development. (n.d.). *Low-Income Weatherization Program*. <https://www.csd.ca.gov/Pages/Low-Income-Weatherization-Program.aspx>

⁸⁸ Workgroups: Building and Energy Technical Experts Large Group Meeting

⁸⁹ Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.

⁹⁰ Workgroups: Landlord Large Group Meeting

⁹¹ Garcia, A.; Savic, R.; and Secoundiata, C. (June 20, 2024). Interviewed by Estolano Advisors.

Landlords also indicated the need for technical assistance to navigate the funding sources available, especially for mom-and-pop landlords who have more limited financial resources and for affordable housing operators who have a unique funding mix.⁹² As part of this, landlords recommended that the County provide a dedicated hub with policy resources, such as a website that streamlines all the available funding resources and rebates that both market-rate and affordable housing landlords can utilize.

(b) Technical Assistance and Funding Support for Tenants

Utility discounts and subsidies are necessary to support tenants with increased electricity costs, but there is a need to promote these programs to support higher participation rates. CBOs and tenants stressed the need for discounts and subsidies to support tenants with their utility bills because the fear of high energy bills deters many low-income tenants from utilizing their cooling systems.^{93 94} CBOs added that the anticipated SoCal Edison 2025 energy rate changes, which will introduce a monthly fee with discounts for low-income customers, will also impact low-income residents' ability to pay their monthly utility bills.^{95 96 97} CBOs also shared about programs that help reduce monthly utility bills, including the California Alternate Rates for Energy Program (CARE), Family Electric Rate Assistance Program (FERA), and Low-Income Home Energy Assistance Program (LIHEAP).⁹⁸ They emphasized that it is important for low-income tenants to be enrolled in discount programs like these, which can help offset the new rate increases and lower utility bills so tenants can use their cooling systems without worrying about costs.

Although these programs can help address utility costs, CBOs and tenants noted that these programs have low participation rates among their communities because they are underpromoted and have high barriers to entry.^{99 100 101 102} One of these barriers is that the applications for these programs often require sensitive personal information that tenants, especially undocumented tenants, may be hesitant to share. CBOs added that these factors, in addition to the time required to complete these forms, could discourage low-income households from applying to discount programs. Several CBOs shared that they have experience helping tenants overcome these obstacles.^{103 104} Therefore, the County can contract with CBOs to host workshops or clinics where they can provide application assistance and direct tenants to subsidies that fit their needs.

Tenants and CBOs were concerned about the costs of relocating temporarily while their buildings undergo major retrofits. Many different participants shared that retrofitting the older building stock in unincorporated LA County may require more than

⁹² Workgroups: Landlord Large Group Meeting
⁹³ Workgroups: Tenants Large Group Meeting (July 30, 2024).
⁹⁴ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024).
⁹⁵ Kirtk, C. (July 2, 2024). Interviewed by Estolano Advisors.
⁹⁶ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024).
⁹⁷ Petersen, M. (2024, May 9). Regulators approve sweeping change to the way most Californians are billed for electricity. *LA Times*. <https://www.latimes.com/environment/story/2024-05-09/cpuc-approves-controversial-change-in-electricity-billing>
⁹⁸ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024).
⁹⁹ *Ibid*.
¹⁰⁰ Kirtk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹⁰¹ Workgroups: Tenants Large Group Meeting (July 30, 2024).
¹⁰² Jasset, A. and Rivera, T. (July 9, 2024). Interviewed by Estolano Advisors.
¹⁰³ Kirtk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹⁰⁴ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024).

just weatherization upgrades.^{105 106 107} Retrofitting may uncover a need for lead or asbestos abatement or electrical upgrades, which might make rental units uninhabitable for an extended period and require tenants to relocate temporarily. Tenants and CBOs were concerned about who would pay for temporary relocation costs.¹⁰⁸ Given that existing buildings may need additional retrofits, and these upgrades may produce associated relocation costs, tenants and CBOs urged the County to consider where those costs will fall. The County's RSTPO requires landlords to pay tenants who need to relocate temporarily due to repairs that require the tenant to vacate the unit.¹⁰⁹ The County should provide clarity regarding whether relocation costs will be covered for buildings outside of the RSTPO or if there will be separate assistance available to help landlords cover the costs of temporary relocation for tenants.

The County should ensure accessible education and outreach and should partner with CBOs to help disseminate information about the policy to tenants. CBOs and a legal services provider stressed that the County should conduct outreach to tenants using multilingual materials and diverse mediums, such as social media, print media, canvassing, and workshops to reach as many residents as possible.^{110 111 112} They also suggested that the County can extend its reach by presenting during community meetings hosted by partner CBOs. CBOs also strongly recommended that the County contract with CBOs to conduct outreach to and educate tenants on the policy and its benefits.^{113 114} Partnering with CBOs that have experience communicating technical concepts to tenants in multiple languages and formats can lead to effective tenant engagement and promote buy-in for the policy. CBOs suggested that the County partner with CBOs by providing them with flyers, content for presentations, and other educational materials to distribute to their community members.¹¹⁵

C. Climate Resilience and Infrastructure

Participants identified potential climate impacts of this policy and strategies to address them. More specifically, they shared considerations for (a) supporting the electric grid, and (b) combining active and passive cooling strategies. This section describes takeaways within each of these themes.

(a) Considerations for the Electric Grid

To address concerns about the policy's potential to increase air conditioning reliance, participants recommended that the County conduct a study on the

¹⁰⁵ Workgroups: Building Technical Experts Large Group Meeting (July 29, 2024)
¹⁰⁶ Workgroups: Tenants Large Group Meeting (July 30, 2024)
¹⁰⁷ Gagnon, J. (July 12, 2024). Interviewed by Estolano Advisors.
¹⁰⁸ Workgroups: Tenants Large Group Meeting (July 30, 2024)
¹⁰⁹ Los Angeles County Code: Rent Stabilization and Tenant Protections §8.52.110. (n.d.)
¹¹⁰ https://library.municode.com/ca/los_angeles_county/codes/code_of_ordinances?nodeId=TT8COPRBUWARE_DIV3HO_CH8.52RE
¹¹¹ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹¹² Lopez, L. (June 20, 2024). Interviewed by Estolano Advisors.
¹¹³ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting
¹¹⁴ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹¹⁵ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting

energy impacts of this policy and promote heat pumps as an energy-efficient solution. Building and energy technical experts and landlords emphasized concerns that more air conditioners would require more energy use and emit more fossil fuels compared to other cooling strategies.^{116 117 118} These participants emphasized that the existing electric grid has energy limitations and does not provide sufficient power needed to maintain day-to-day power usage at current levels. Extreme weather further affects grid reliability, putting the power system at risk.¹¹⁹ These effects can further impede efforts to combat extreme heat.

Some participants offered strategies to address potential challenges with increased energy use on the electric grid. One landlord urged the County to conduct a study that evaluates the power grid's capacity alongside the energy that a policy like this would require in order to address potential grid limitations.¹²⁰ Another participant also suggested that the County conduct this study with a focus on equity to determine what proportion of increased energy use would be among low-income and vulnerable households as compared to existing energy demands.¹²¹

Building and energy technical experts and CBOs also urged the County to promote the use of heat pumps, given that they are more energy efficient compared to air conditioners and have grid-stabilizing properties.^{122 123 124 125} This would align with the state's draft 2025 Building Energy Efficient Standards recommendations to promote a wider use of heat pumps.¹²⁶ Heat pumps are more energy efficient than other cooling and heating systems because they transfer air movement rather than generating it.¹²⁷ This results in lower energy consumption which can help improve the resilience of the electric grid. While heat pumps require more up-front costs than other cooling strategies, they can also supply more extensive energy savings over time.¹²⁸ Heat pumps also operate at high efficiency all year as they provide cooling during summer and heating during winter.¹²⁹ This broad applicability supports building and energy technical experts' emphasis that the policy should apply all-year given the risk of high temperatures in every season, which aligns with how the City of Dallas implements its policy.^{130 131} Given the grid-stabilizing and energy-efficiency benefits of heat pumps, building and energy

¹¹⁶ Workgroups: Landlord Large Group Meeting (July 29, 2024)
¹¹⁷ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹¹⁸ O'Neill, T.; Rhodes, M.; and Wright, J. (August 12, 2024). Interviewed by Estolano Advisors.
¹¹⁹ Walsh, C. (2022, June 14). *Building a Climate-Resilient Grid*. NRDC. <https://www.nrdc.org/bio/christy-walsh/building-climate-resilient-grid> (accessed August 19, 2024).
¹²⁰ Workgroups: Landlords Large Group Meeting (July 25, 2024)
¹²¹ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.
¹²² Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹²³ Friedman, I. and Walker, O. (June 18, 2024). Interviewed by Estolano Advisors.
¹²⁴ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹²⁵ Workgroups: Tenants' Rights' Groups/CBOs Large Group Meeting
¹²⁶ Borgeson, M. (2024, April 26). *Heat Pumps are Coming to New CA Homes. What About Existing Homes?*. NRDC.
¹²⁷ Lang-Ree, C., & Velez, K. (2022, October 5). *Want to cut heating costs? Replace your A/C*. NRDC. <https://www.nrdc.org/bio/kiki-velez/want-cut-heating-costs-replace-your-ac-0> (accessed August 13, 2024).
¹²⁸ Borgeson, M. (2024, April 26). *Heat Pumps are Coming to New CA Homes. What About Existing Homes?*. NRDC.
¹²⁹ Lang-Ree, C., & Velez, K. (2022, October 5). *Want to cut heating costs? Replace your A/C*. NRDC. <https://www.nrdc.org/bio/kiki-velez/want-cut-heating-costs-replace-your-ac-0> (accessed August 13, 2024).
¹³⁰ Workgroups: Building Technical Experts Large Group Meeting (July 29, 2024)
¹³¹ Garcia, A.; Savic, R.; and Secoundata, C. (June 20, 2024). Interviewed by Estolano Advisors.

technical experts and CBOs wanted the County to promote this strategy over traditional air conditioners to support climate goals, grid resilience, and cost efficiency.

(b) Active and Passive Cooling Strategies

Combining weatherization and passive cooling elements with active cooling is critical for effective heat reduction and cost and energy efficiency. Building and energy technical experts and a CBO noted that upgrading the building envelope by installing passive cooling strategies will help offset some of the need for active cooling devices.^{132 133 134} Passive cooling mechanisms, including ventilation, cool roofs, insulation, window shutters, window tints/films, operable windows, and other updates to the building envelope are critical to have in place before introducing active cooling elements.¹³⁵ This is because passive cooling strategies can reduce the amount of active cooling needed, thereby reducing utility bills, relieving stress on the electric grid, and expanding heat resilience.¹³⁶ These participants emphasized the importance of combining passive cooling and active cooling strategies to ensure more effective heat reduction along with utility cost savings.

Costs and geographic location will determine which passive cooling strategies are most effective for a given building, so landlords will need to understand these factors when making decisions about retrofits. A building and energy technical expert noted that passive cooling costs can vary widely.¹³⁷ Building owners will need to consider these factors when making decisions about what types of upgrades to implement. For example, window tints/films, which block out or reflect solar energy to reduce heat transfer, are particularly effective and affordable.^{138 139} Other strategies like cool roofs often cost more, though they can also produce effective results. Further, building owners will need to understand factors like the air quality around their buildings and the directions their buildings face to select the most appropriate upgrades. For example, building and energy technical experts shared that while open windows can be effective for cooling down units in areas with good air quality, areas that experience poor air quality cannot use operable windows as a reliable cooling solution.¹⁴⁰ Further, landlords and building and energy technical experts noted that building owners will need to consider from which direction their buildings receive sunlight in order to determine where to position shade structures or whether window coverings will be effective.^{141 142} Therefore, these participants emphasized that building owners will need to understand the costs and unique location of their buildings when determining which passive cooling

¹³² Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)

¹³³ Jasset, A. and Rivera, T. (July 9, 2024). Interviewed by Estolano Advisors.

¹³⁴ Stapleton, B. (June 24, 2024). Interviewed by Estolano Advisors.

¹³⁵ *Ibid.*

¹³⁶ Specian, M. (2023, June 14). *Weatherization is Key to Effective, Low-Cost Building Electrification*. ACEEE.

¹³⁷ <https://www.aceee.org/blog-post/2023/06/weatherization-key-effective-low-cost-building-electrification>. ACEEE. (accessed August 14, 2024).

¹³⁸ *Ibid.*

¹³⁹ Progressive. (2023, September 27). *Benefits of Tinted House Windows*. <https://www.progressive.com/answers/benefits-of-tinted-house-windows/> (accessed August 14, 2024).

¹⁴⁰ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)

¹⁴² Workgroups: Landlord Large Group Meeting

strategies to implement; technical assistance could support landlords with this information.

Shading, urban greening, and other large-scale cooling strategies provide broader community benefits that the County should support alongside this policy. Landlords, CBOs, and building and energy technical experts agreed that cooling strategies need to go beyond the building envelope to fully address the impacts of extreme heat on communities.^{143 144 145} These participants emphasized that trees, shade structures, permeable land cover, and cool pavement can cool down public spaces which are under the County's jurisdiction. Implementing these strategies at the neighborhood level can provide additional spaces for residents to cool off. Some strategies such as shade can also reduce temperatures in rental units when cast on buildings.^{146 147} One participant highlighted Phoenix's Tree and Shade Master Plan as an example of how cities can prioritize shade and tree plantings at a larger scale.^{148 149} While these participants understood that the policy would not address community-wide cooling strategies, they strongly encouraged the County to consider how it can promote these broader approaches to cooling alongside a maximum indoor temperature threshold policy.

D. Collaboration with Other Policy Efforts

Participants shared about several decarbonization, energy efficiency, and maximum indoor temperature policy and funding efforts at the local, state, and federal levels. Aligning the County's maximum indoor temperature policy with these efforts can further strengthen the policy and provide additional resources to support the policy's success.

(a) City and County of Los Angeles' Decarbonization Policies

Participants wanted to see coordination between the County's maximum indoor temperature policy and the City's and County's decarbonization policies. In 2022, the City of Los Angeles passed its residential building decarbonization policy, which requires newly constructed residential buildings within the city's limit to be all-electric starting in 2023.¹⁵⁰ In the same year, the LA County Board of Supervisors passed the motion "Ensuring the Equitable Decarbonization of Buildings," which directs various County departments to develop a strategy for equitable decarbonization through community engagement, determine infrastructure needs and the energy grid's capacity, and identify funding sources that support decarbonization.¹⁵¹ Because the County's maximum indoor temperature policy and Los Angeles' decarbonization goals overlap, building and energy technical experts, CBOs, and tenants wanted the County to think

¹⁴³ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹⁴⁴ Workgroups: Landlord Large Group Meeting
¹⁴⁵ Workgroups: Tenants' Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
¹⁴⁶ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹⁴⁷ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.
¹⁴⁸ *Ibid.*
¹⁴⁹ City of Phoenix. (2010). *Tree and Shade Master Plan*. https://www.phoenix.gov/parks/site/Documents/PKS_Forestry/PKS_Forestry_Tree_and_Shade_Master_Plan.pdf
¹⁵⁰ City of Los Angeles. (2022). *Ordinance No. 187714*. https://clktrep.lacity.org/online/docs/2022/22-0151_ord_187714_1-23-23.pdf
¹⁵¹ LA County Board of Supervisors. (2022, March 15). *Ensuring the Equitable Decarbonization of Buildings*. <https://assets-us-01.kcusercontent.com/0234f496-d2b7-00b6-17a4-b43e949b70a2/32a59209-9328-4010-a52d-fc8bb6ea5d628/167238.pdf>

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about these policies in tandem with the proposed maximum indoor temperature threshold ordinance.^{152 153 154 155 156 157}

(b) City of Los Angeles' Motion to Require Indoor Cooling in Residential Units

Participants wanted to see coordination between the County's maximum indoor temperature threshold policy and the City of Los Angeles' proposed indoor cooling requirement. In 2023, the Los Angeles City Council passed a motion to begin the process of establishing a city-wide indoor cooling requirement.¹⁵⁸ Building and energy technical experts and CBOs emphasized the need to coordinate on the policies at both the city and county levels given the overlaps.^{159 160} The County should continue to follow the City's indoor cooling policy as it develops and coordinate with relevant City staff.

(c) State of California's Decarbonization and Energy Efficiency Policies

Participants wanted to see alignment between this policy and the AB 209 Maximum Safe Indoor Air Temperature Policy Recommendation Report. In June 2024, HCD released a draft AB 209 report that outlined a set of recommendations for maximum indoor temperature thresholds in new construction. CBOs emphasized the need for the County to coordinate with HCD as it continues to refine this report and its recommendations.¹⁶¹

Participants wanted to see alignment between this policy and the new State Building Energy Efficient Standards. In 2024, the California Energy Commission proposed a set of changes in the draft 2025 Building Energy Efficient Standards that will include updates to its heat pump requirements for newly constructed residential buildings starting in 2026.¹⁶² One CBO recommended aligning the County's maximum indoor temperature policy with these upcoming Building Energy Efficient Standards to streamline and encourage the installation of heat pumps.¹⁶³

(d) Federal Policies and Funding for Decarbonization and Energy Efficiency

Participants underscored that there are federal policies and funding opportunities that promote decarbonization and energy efficiency and that could support this policy. CBOs and other participants pointed to the 2022 Inflation Reduction Act (IRA) as an important source of funding for decarbonization and energy efficiency upgrades.^{164 165}

¹⁵² Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting
¹⁵³ Workgroups: Building/Energy Technical Experts Large Group Meeting (July 29, 2024)
¹⁵⁴ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹⁵⁵ Stapleton, B. (June 24, 2024). Interviewed by Estolano Advisors.
¹⁵⁶ Friedman, I. and Walker, O. (June 18, 2024). Interviewed by Estolano Advisors.
¹⁵⁷ Workgroups: Tenants Large Group Meeting (July 30, 2024)
¹⁵⁸ City of Los Angeles. (2023). *Housing and Homelessness Committee Report*. https://clikrep.lacity.org/online/docs/2023/23-0453_rpl_hh_05-17-23.pdf
¹⁵⁹ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting (July 22, 2024)
¹⁶⁰ Stapleton, B. (June 24, 2024). Interviewed by Estolano Advisors.
¹⁶¹ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting
¹⁶² Borgeson, M. (2024, April 26). *Heat Pumps are Coming to New CA Homes. What About Existing Homes?*. NRD. <https://www.nrdc.org/bio/merrian-borgeson/heat-pumps-are-coming-new-ca-homes-what-about-existing-homes>
¹⁶³ Kirk, C. (July 2, 2024). Interviewed by Estolano Advisors.
¹⁶⁴ Workgroups: Tenants Rights' Groups/CBOs Large Group Meeting
¹⁶⁵ Stapleton, B. (June 24, 2024). Interviewed by Estolano Advisors.

¹⁶⁶ The IRA earmarked \$369 billion for energy efficiency and climate change projects, including residential electrification through the High-Efficiency Electric Home Rebate Act (HEEHRA). ¹⁶⁷ The HEEHRA funds states to provide rebates for landlords, such as up to 100% of electrification costs for low-income homes and up to 50% for moderate-income homes, including multifamily buildings. ¹⁶⁸ ¹⁶⁹ Although California has submitted their application to receive funding from HEEHRA, it has not yet received these funds. ¹⁷⁰ Additionally, California's HEEHRA program is still under development, so it is not yet clear exactly how much funding landlords will be able to receive nor what kinds of improvements will be eligible for funding. ¹⁷¹ However, because this could be a funding opportunity that can directly support the implementation of this program, the County should track this program as it develops.

IV. RECOMMENDATIONS

This section summarizes this report's recommendations based on stakeholder feedback. Recommendations are organized into: (1) policy considerations, (2) resources and support, (3) climate resilience and infrastructure, and (4) collaboration with other policy efforts.

A. Policy Considerations

(a) Temperature Threshold Considerations

Continue to follow recent research to inform a temperature threshold that is based on robust data and is easily justifiable to stakeholders. The County should reference data and other relevant sources to justify the temperature threshold. The County should also explain the rationale behind the selected temperature to ensure stakeholders fully understand the threshold, its impacts on public health, and the implications for older buildings.

Conduct a study that evaluates the cost and energy impacts of the policy to determine funding needs. The County should conduct a study that looks at the costs and energy-use impacts of achieving the selected maximum indoor temperature threshold. The study can focus on evaluating the costs associated with electric upgrades and retrofits and how those vary by building stock. Additionally, the study can assess the electric grid's capacity and identify strategies to mitigate the impacts of increased energy on the electric grid. The County should use this study to inform anticipated funding needs for building owners and strategies to promote grid resilience.

¹⁶⁶ Turner, V. K. (August 20, 2024). Interviewed by Estolano Advisors.
¹⁶⁷ Rewiring America. (n.d.). *The Electric explainer: Key Programs in the Inflation Reduction Act and What They Mean for Americans*. <https://www.rewiringamerica.org/policy/inflation-reduction-act>
¹⁶⁸ Rewiring America. (n.d.-a). *High-Efficiency Electric Home Rebate Act*. <https://www.rewiringamerica.org/policy/high-efficiency-electric-home-rebate-act>
¹⁶⁹ California Energy Commission. (n.d.-b). *FAQ: IRA Residential Efficiency and Electrification Rebates*. California Energy Commission. <https://www.energy.ca.gov/programs-and-topics/programs/inflation-reduction-act-residential-energy-rebate-program/faq-ira#:~:text=Under%20the%20Home%20Efficiency%20Rebates,buildings%2C%20may%20apply%20for%20rebates.>
¹⁷⁰ *Ibid.*
¹⁷¹ *Ibid.*

(b) Tenant Protections

Reference existing jurisdictions' policies to determine how to address unintended consequences for tenants. The County should reference other jurisdictions' policies, such as the City of LA's Equitable Decarbonization Policy or the City of South Pasadena's Just Cause for Eviction Ordinance, which stipulate that substantial remodeling does not provide justification for evictions. These policies can provide the County with examples for addressing tenant concerns regarding potential evictions due to building upgrades. Similarly, the County should review programs such as the State of Washington's Sustainable Energy Trust Loan Program or the City of LA's Decarbonization Program to ensure the policy addresses displacement concerns for tenants and cost concerns for landlords. The County can consider researching and adapting from these models to ensure the policy addresses both landlord and tenant concerns.

(c) Phased Implementation Timeline

Consider a phased implementation timeline that prioritizes the most vulnerable areas and provides support for early adopters. The rollout should be phased to prioritize heat vulnerable areas and consider the implementation needs of older buildings. The County should consider focusing early adoption in the most heat-vulnerable areas based on the County's Climate Vulnerability Assessment. The County will need to ensure that small landlords, affordable housing operators, and older buildings in these areas get funding and technical assistance to support with this early adoption. Given the scale of upgrades needed in older buildings and the unique funding structures for affordable housing, small landlords and affordable housing operators in non-heat vulnerable areas will likely need more time for compliance in addition to funding and technical assistance.

(d) Enforcement

Integrate this policy's enforcement into an existing County program, such as the new Rental Housing Habitability Program. The RHHP, which will go into effect in October 2024, will conduct its own regularly scheduled inspections, which provides an opportunity to integrate inspections for this policy with this new program. Adding an additional area of inspections to the program may require additional time and therefore more staff, so the County should ensure there is sufficient dedicated staff to meet any additional inspection needs.

Establish a transparent and accessible reporting system for residents to report landlord non-compliance. To support enforcement of the policy, the County should ensure that residents are able to easily report landlord non-compliance. The County should ensure that the system is accessible and available in multiple languages for the reporting system to be effective. This will help establish trust among tenants and ensuring timely reporting of non-compliance issues.

(e) Considerations for Mobile Homes

Conduct a review of mobile home regulations in LA County to determine whether this policy could support renters in mobile homes. While the County may not have authority to regulate construction upgrades of mobile homes, the County should conduct a study to determine whether there are opportunities for the County to support renters in this building type.

B. Resources and Support

(a) General Support

Provide a central location with information on the policy and supportive resources, such as rebates and subsidies, for landlords and tenants. The County should compile and streamline information and resources that landlords and tenants will need to comply with the policy in one central location. This could look like a dedicated website for this policy that has separate webpages for tenants and landlords. The landlords' webpage should have information on policy compliance and enforcement, technical assistance opportunities, and funding resources for market-rate and affordable housing. The tenants' webpage should be language accessible and include information on tenant protections, utility subsidy programs, and details about any town halls or other informational meetings the County will be hosting.

(b) Support for Landlords

Contract with experienced TA providers to support landlords with complying with the policy and applying for funding and rebates. The County should facilitate TA for landlords, especially for smaller mom-and-pop landlords and affordable housing operators, to ensure they can successfully comply with the policy. TA providers can support landlords with implementing the policy requirements, identifying funding opportunities, and selecting appropriate active and passive cooling options. The County can also provide workshops to various landlord association groups to educate them on the policy and answer questions.

(c) Support for Tenants

Contract with CBOs to share information regarding the policy and provide technical support to tenants. CBOs can help tenants navigate utility subsidy applications and the policy's reporting system. They can also support the County with sharing accurate and multilingual information on the policy to tenants.

Estimate the number of rental units that will require tenant relocation assistance and determine how to address these relocation costs. Based on the findings from the recommended energy and cost study, the County should estimate the number of buildings that will need extensive retrofits. With this context in mind, the County should identify how many tenants may need relocation assistance and whether it will be feasible to support tenants and landlords with addressing these costs.

C. Climate Resilience and Infrastructure

Collaborate with other County departments pursuing relevant initiatives to promote community-wide cooling strategies in tandem with the policy. DPH should coordinate with other County departments working on climate initiatives, such as the Chief Sustainability Office, to support funding opportunities for projects that will increase urban greening and shading in the most heat-vulnerable areas in unincorporated LA County.

D. Collaboration with Other Policy Efforts

Collaborate with the City of LA and HCD to align the maximum indoor temperature threshold with local and state decarbonization and temperature threshold policies. Because there are synergies between the City of LA's and the State's decarbonization and maximum indoor temperature policies, the County should continue to identify opportunities to align its maximum indoor temperature policy with these efforts. This could look like regularly coordinating with the relevant agencies to keep up to date on policy development.

Coordinate with SoCal Edison on the policy's implementation and access to federal and state funding to expand utility subsidies and retrofit rebates available. The County should coordinate with SoCal Edison to share updates on the policy's implementation and progress to identify existing rebates and subsidies that can support tenants and landlords. The County can also collaborate with SoCal Edison to promote expansion of existing discount and rebate programs through additional funding from federal and state government.

Track the progress of the proposed California 2025 Building Energy Efficient Standards and its guidance around heat pumps. Although the 2025 Building Energy Efficient Standards are still in draft form, guidelines around heat pumps for new and existing buildings are in the proposal. The County should track the progress of these standards to stay up to date on potential requirements and whether there will be stipulations for heat pumps in new buildings. This will help the County determine how the state's heat pump guidance will affect policy implementation.

