

Keeping California Housing Safe in a Warming World

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Keeping California Housing Safe in a Warming World

Objective

- Develop policy to define maximum safe thermal conditions for California residential buildings and ensure that housing can maintain those conditions

Methods

- Critical literature review
- Stakeholder workshops
- Model energy impacts of policy options
- Policy development

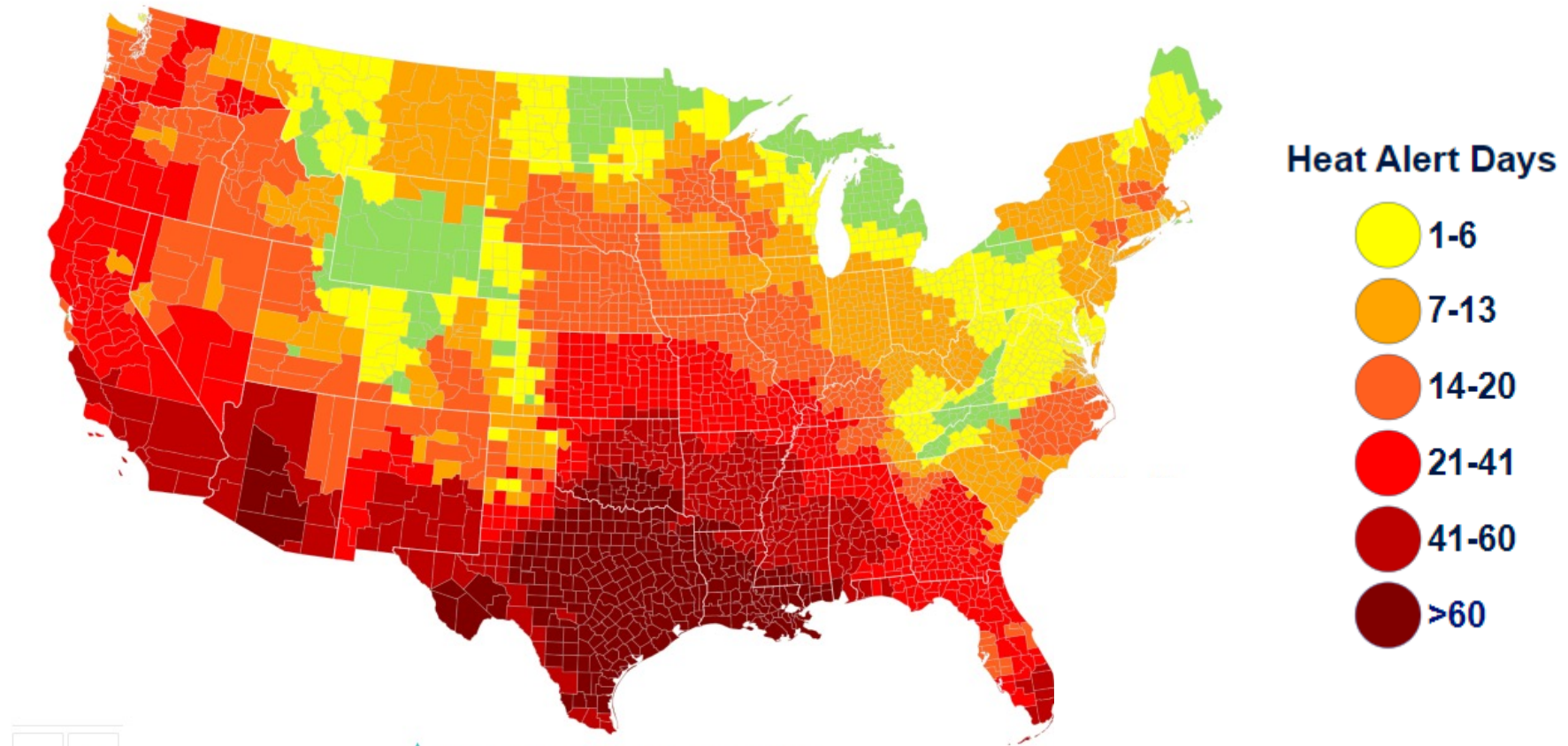
Funding

- California Dept. of Housing and Community Development



Photo by Breno Assis on Unsplash

U.S. Heat Alerts in 2023



<https://www.citizen.org/article/mapping-heat-alerts-summer-2023>

Indoor Temperatures



What is a safe indoor upper temperature limit?

77 °F?

82 °F?

90 °F?

80 °F?

85 °F?

Literature Search Summary

- We reviewed over 300 references across many disciplines
 - Large metadata studies – hospitalizations, morbidity, mortality
 - Chamber experiments – physiological response to heat
- There is a large body of work linking high outdoor temperatures to health outcomes
- Thermal comfort in hot conditions is very well understood
- Acute heat illness (heat exhaustion, heat stroke) is reasonably well understood for military personnel, athletes, certain workforces

- No definitive work on safe upper temperature limits for health

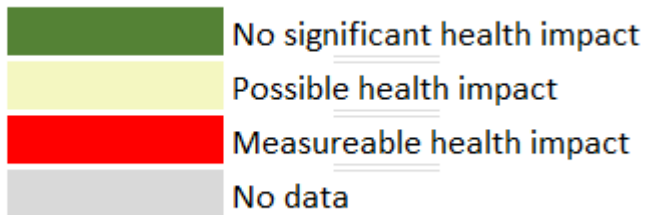
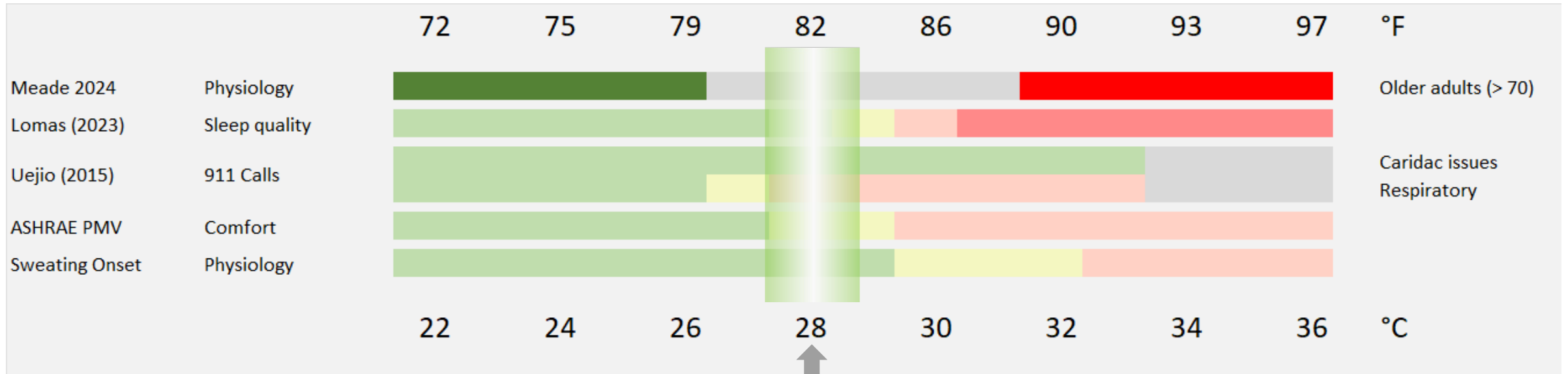
World Health Organization Housing and Health Guidelines (2018)

“...no firm answer can be given to the question of whether people living in housing with a temperature above 24 °C [75.2 °F] have worse health outcomes than those living in housing with an indoor temperature below that threshold.”

Existing U.S. Residential Upper Temperature Limits

State	City/County	Limit
TX	El Paso	90°F (32°C)
TX	Dallas	85°F (29°C)
NV	Clark County (Las Vegas)	85°F (29°C)
CA	Los Angeles (draft)	82°F (28°C)
AZ	Tempe	82°F (28°C)
AZ	Phoenix	82°F (28°C)
AZ	Tucson	82°F (28°C)
TX	Houston	80°F (27°C)
CA	Palm Springs	80°F (27°C)
LA	New Orleans	80°F (27°C)
MD	Montgomery	80°F (27°C)
OR	Portland	78°F (26°C)

Temperature Ranges Evaluated in the Literature



Proposed
limit

Vulnerable Populations

Age

- Elderly
- Children under 5
- Infants

Social Context

- Low-income
- Living alone
- ...

Physical Health

- Blood pressure
- Heart disease
- Diabetes
- Respiratory
- ...

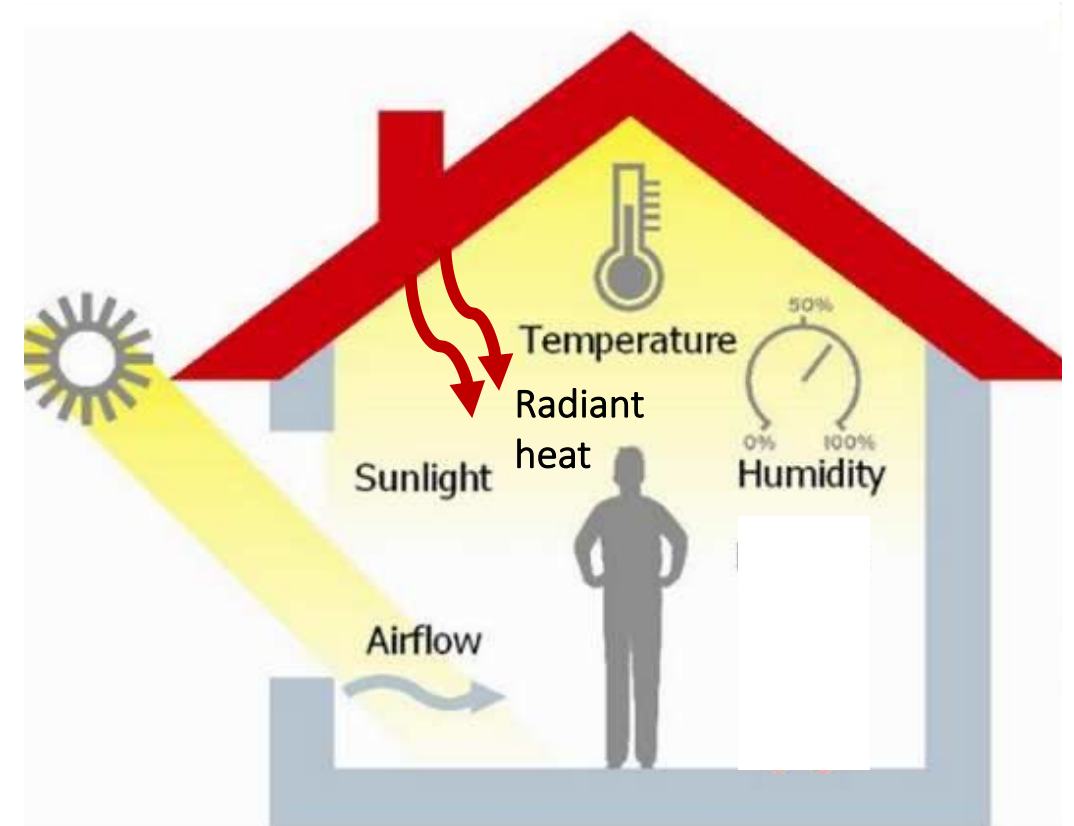
Mental Health

- Dementia
- Schizophrenia
- ...

In warm conditions,
temperature is not the
only factor impacting
thermal comfort
and health

Major variables influencing thermal comfort

- Air temperature
- Mean radiant temperature
- Air speed
- Humidity
- Metabolic activity
- Clothing



Air motion can provide a significant cooling effect



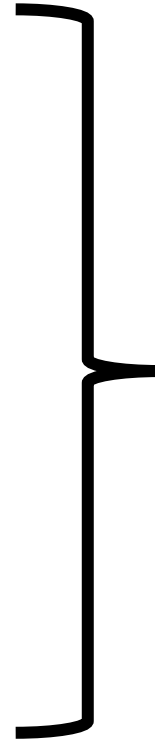
82°F, still air

=



87°F, with fan

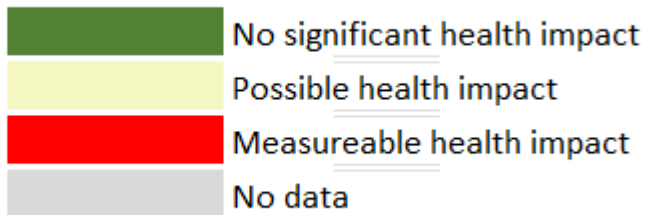
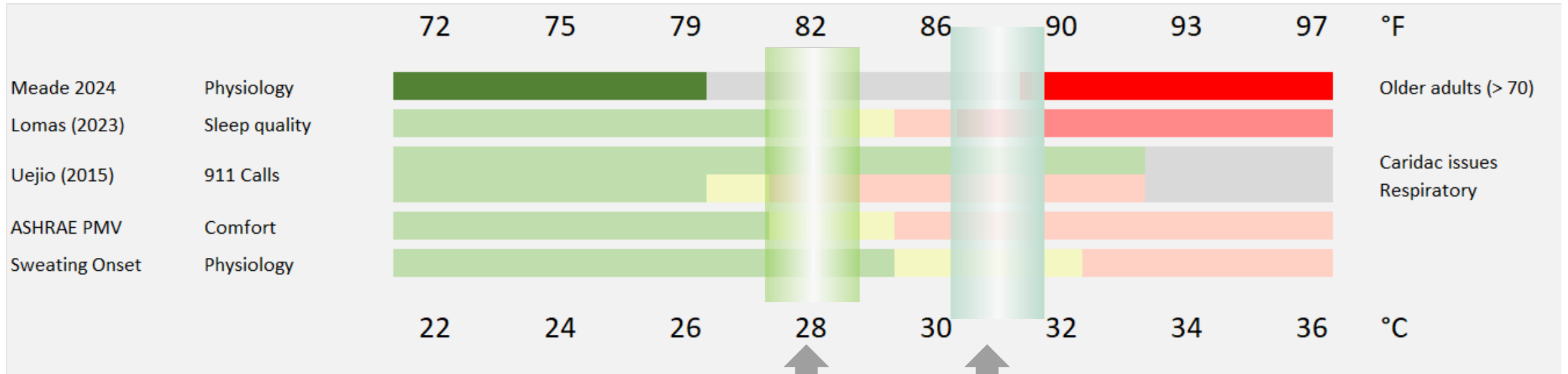
- Air temperature
- Mean radiant temperature
- Air speed
- Humidity
- Clothing
- Metabolic rate



**Standard Effective
Temperature
(SET)**

The temperature of an environment at 50% relative humidity and still air in which a subject would have the same heat loss as in the actual environment

Temperature Ranges Evaluated in the Literature



Still air

Air motion

Impact of an indoor upper temperature limit

- **Unlikely to impact occupant behavior (e.g., thermostat settings)**
- **Unlikely to impact most home owners**
- **Biggest impact on low-income rental housing**
 - Could provide a basis for requiring landlords to provide a means to keep housing cool

Q&A

Next steps

- Public draft due May 31 for 2 week comment period
- Finalize policies and report over the summer

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- Please join the breakout session on Policy Brainstorming for Heat Resilient Housing

