EBMUD Landscape Advisory Committee General Meeting

Strategies to Prevent Urban Heat in WaterWise Landscapes

February 4, 2025

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EBMUD Water Conservation Program Manager

Announcements

CEU's available - UC Master Gardeners, QWEL, ReScape, and AWWA

Save the Date

- Feb 6, 9-11:30 G3 The New Commercial Landscape (webinar)
- February 27 - Valley Water Landscape Summit in San Jose (hybrid); Allied Landscape in Pleasanton– Professional Training
- March 11, 2025 2pm-4pm – Strategies to Prevent Urban Heat in Oakland (in-person)
- April 26th – Ruth Bancroft Garden Tour
- May 3rd and 4th – Bring Back the Natives Garden Tour
- May 22nd – CA Green Building Conference

LAC Project Committee – Revising EBMUD's Low Water Plant list

City of Alameda DRAFT Urban Forest Plan; **City of Oakland** Urban Forest Plan

Landscape Rebates

- **NEW!** Lawn Conversion Payback Calculator
- Standard - $1.00/ sq. ft; Super - $2.00/sq. ft.; and Median Strip - $2.00/sq. ft.
- Up to $20,000 for commercial properties (ends Dec 2026)
- **NEW!** Spring Irrigation Repair Jan 2025 – March 2025 ($30/station)
- Irrigation Flow Sensor – up to $250
- **NEW!** Account Manager and HOA Board meetings (invite EBMUD)
- Landscape Design Assistance Program – completed 2 years

EBMUD Water Supply

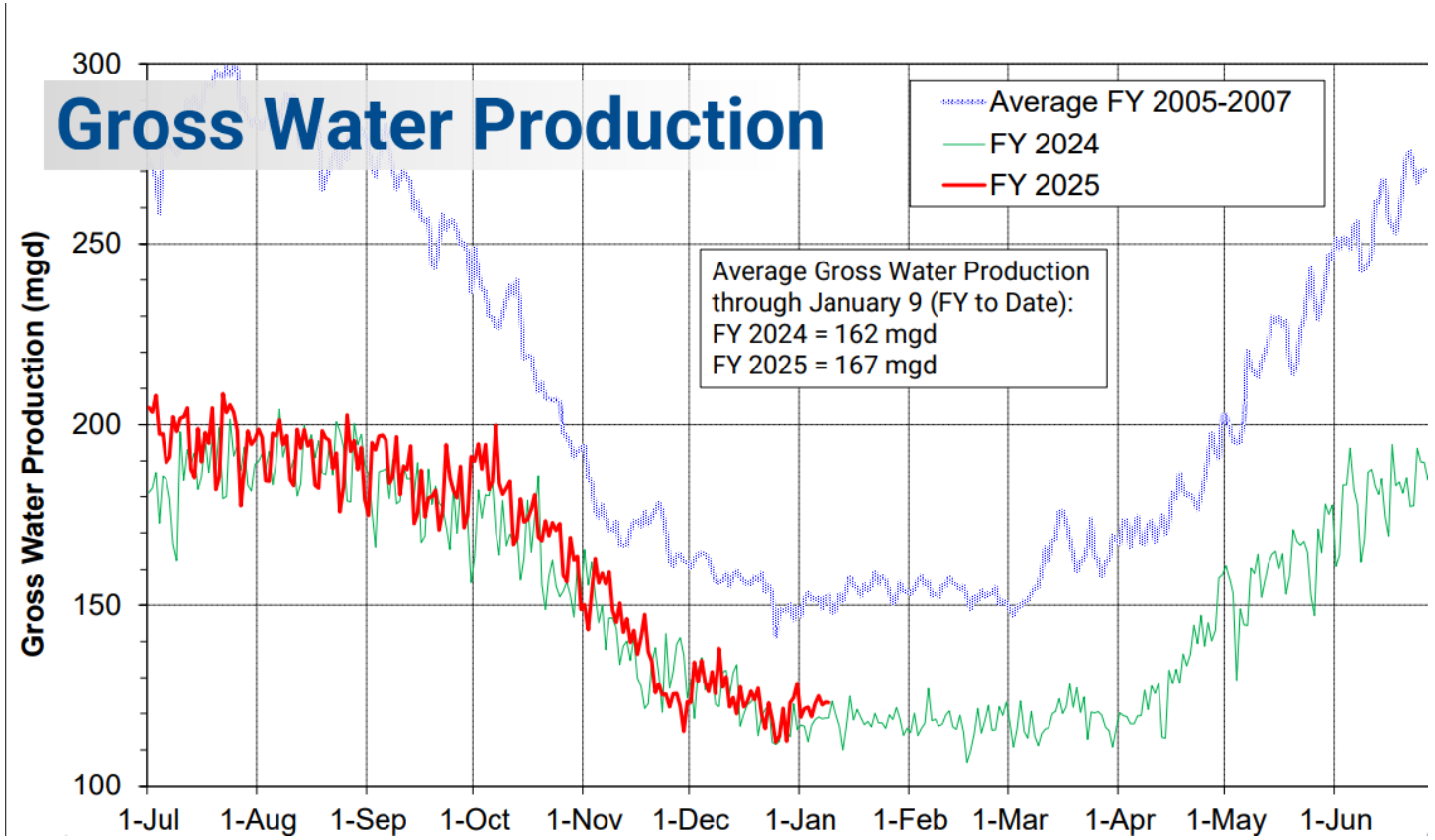
Total system storage - 78% Full

Total system storage average – 106%

Precipitation

- Mokelumne 67% of average
- Local Area 72% of average

Creating a Conservation Culture



CA Water Conservation Legislation

- **Non-Functional Turf Watering Ban for Commercial Properties** (AB 1572)
  - Government properties 2027
  - Institutional 2028
  - Homeowner associations 2029
  - Public lands in disadvantage communities 2031 or as funding is available.

- **Making Water Conservation a California Way of Life** (SB 606 and AB 1668)
  - Indoor and outdoor water use targets have been set for residential, institutional, and industrial sectors;
  - Targets require an increase in water efficiency over time.
  - Proper controller scheduling identified as a key strategy to reduce water use.

LEF = Landscape Efficiency Factor

Landscape Professional Training

- ReScape California
- Qualified Water Efficient Landscaper (QWEL)
- California Native Plant Society Landscaper Certification Program
- California Landscape Contractors Association
- Irrigation Association
- G3 Watershed Wise Landscape Training
- EBMUD Landscape Advisory Committee workshops
- UC Cooperative Extension Landscape Professional Training **Survey**

Strategies to Prevent Urban Heat

with WaterWise Landscapes

Dr. Pouya Vahmani, Urban Environmental Scientist in the Climate and Ecosystem Sciences Division at the Lawrence Berkeley National Laboratory.

Pouya's recent research includes extreme heat and energy demand in cities, municipal water conservation and heat mitigation, and heat mitigation and climate adaptation in urban areas.

Ph.D. Hydrology and Water Resources Engineering, UC Los Angeles, 2013; M.S. Environmental Engineering, CSU Los Angeles, 2009; B.S. Civil Engineering, Shahid Bahonar University of Kerman, Iran 2005

- **Factors that contribute to Urban Heat; Impact of cool roofs on air temperature and irrigation.**

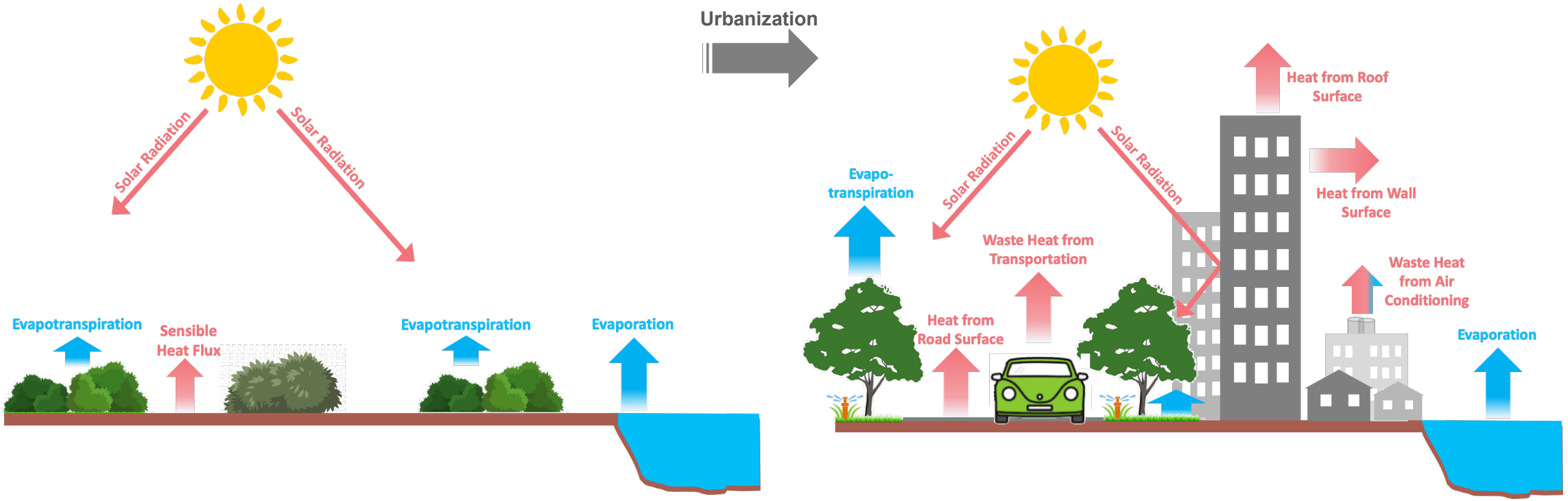
Dr. Joanna Solins, Environmental Horticulture Advisor with the UC Division of Agriculture and Natural Resources

Joanna conducted postdoctoral research on green stormwater infrastructure, urban forest composition, and the water demand of urban vegetation across California, and contributed to projects examining residential landscaping and urban heat in Sacramento.

Ph.D. Ecology, UC Davis. 2018; M.A. Geography, UC Davis. 2016; B.A. Environmental Studies, Vassar College. 2004

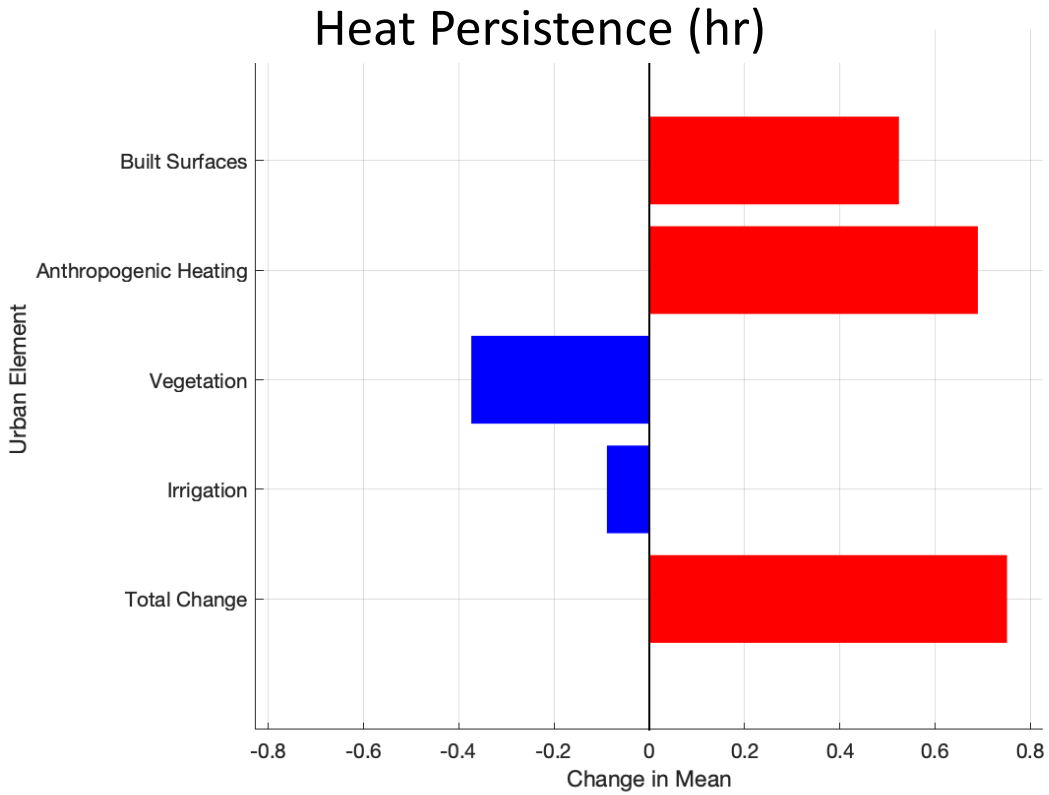
- **Effects of turf conversion and tree canopy on localized heat.**

Factors contributing to URBAN HEAT



Impacts of Urban features on extreme heat conditions

- Built surfaces and anthropogenic heating (waste heat) extend extreme heat conditions by +1 hour
- Vegetation and irrigation shorten extreme heat conditions by -0.5 hours

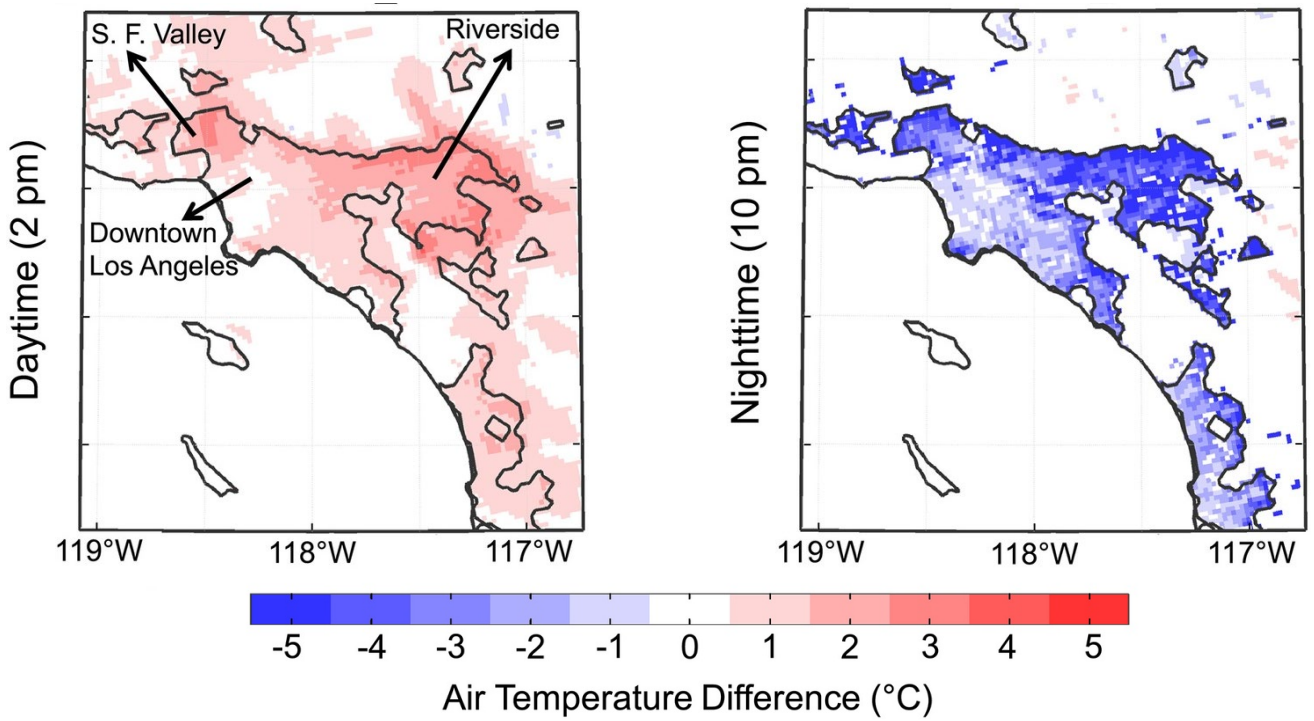


Lawrence Berkeley National Lab (ongoing study)

Climatic consequences of adopting drought-tolerant vegetation in Los Angeles

+1.9°C

DAYTIME WARMING EFFECT



Surface Reflectivity and Albedo Enhancement

Cool Roofs & Cool Pavements: Using reflective materials for roofs and pavement reduces heat absorption and lowers surface temperatures.

Urban Greening & Vegetation

Tree Canopy Expansion

Green Roofs & Green Walls

Urban Forests & Parks

Water-Based Cooling Strategies

Urban Water Bodies & Fountains: Lakes, ponds, and fountains create localized cooling effects.

Mist Systems & Evaporative Cooling: Using misting stations in public spaces cools the air.

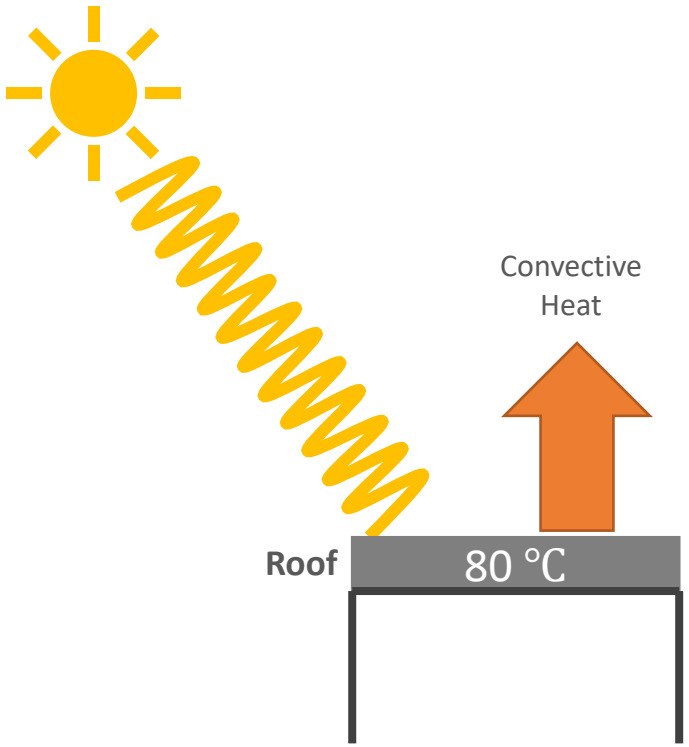
Urban Layout & Design

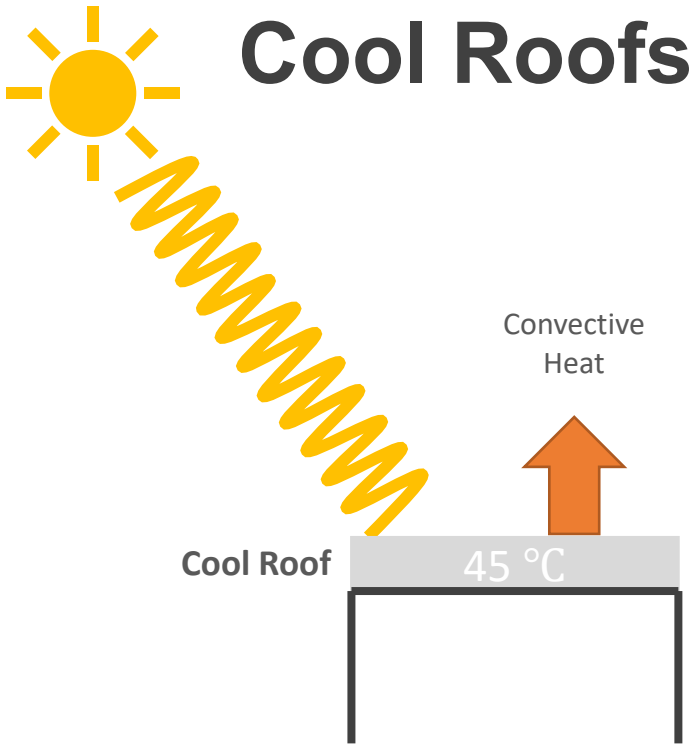
Ventilation Corridors: Designing open spaces and wide streets to allow air circulation.

Building Orientation & Spacing can reduce heat trapping and improve natural ventilation.

Cool Roofs

Cool Roofs

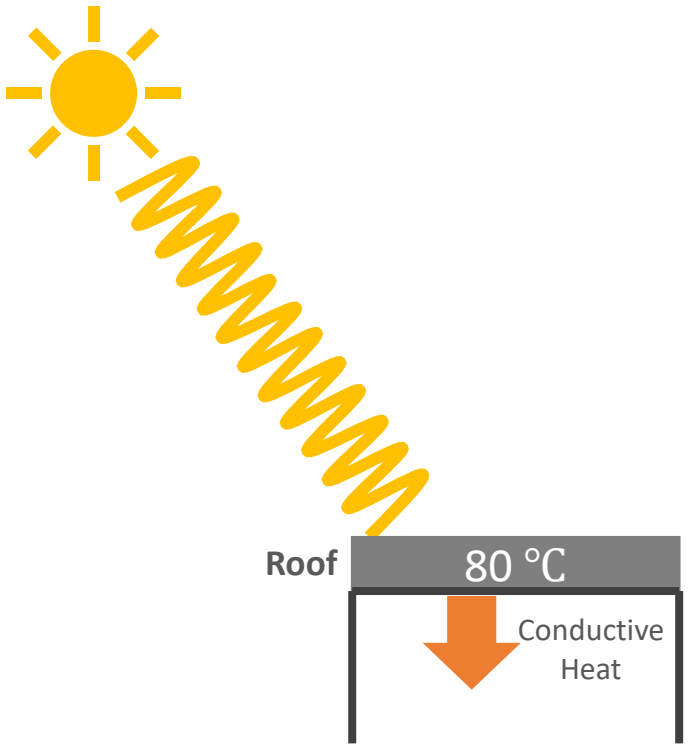


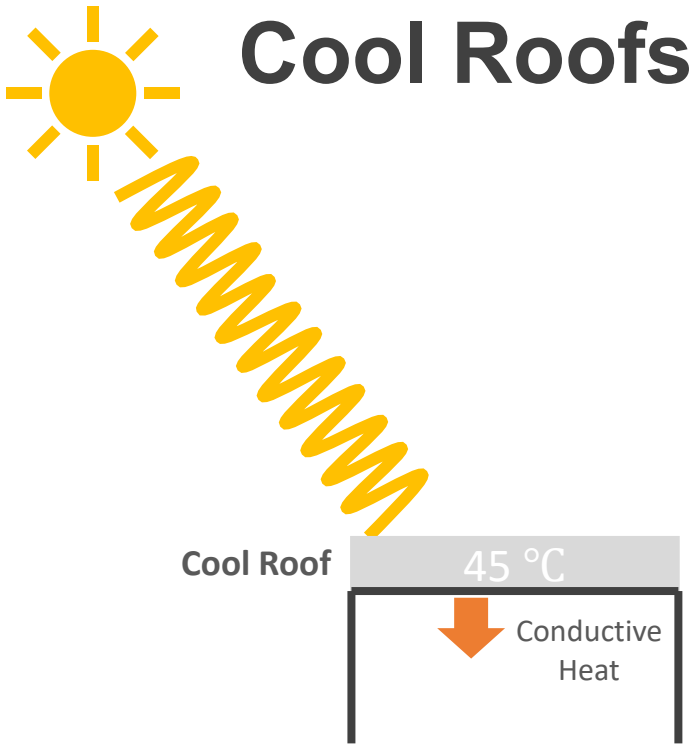


Benefits

Convective Heat ▼ ⇢ Air temp. ▼

Cool Roofs



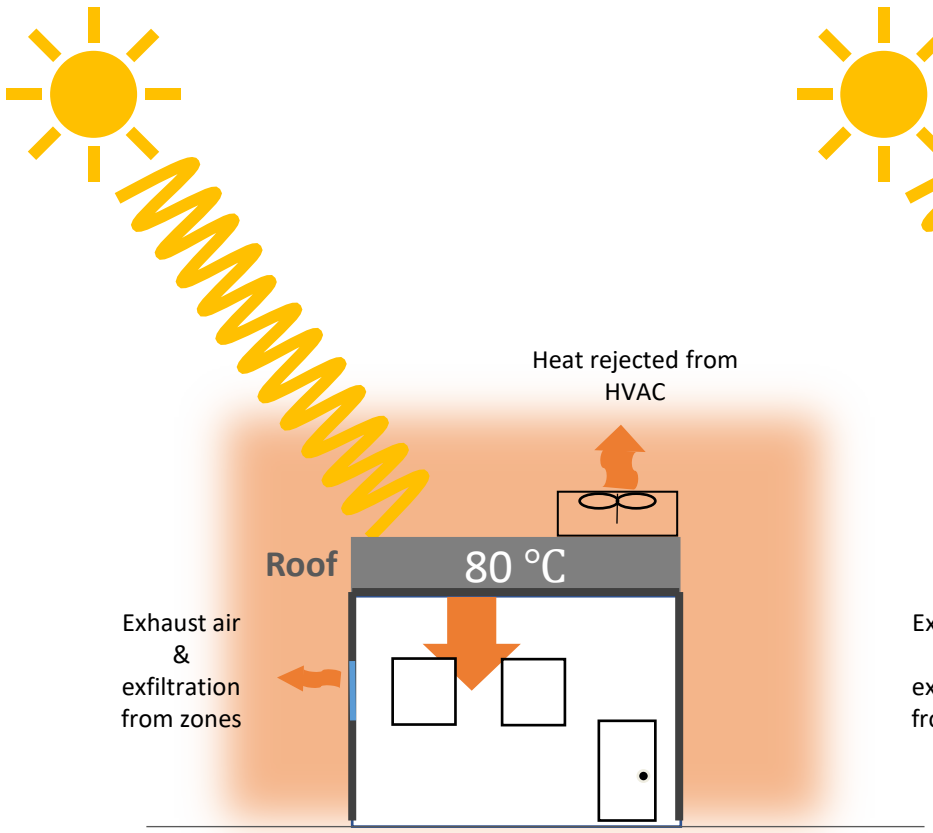


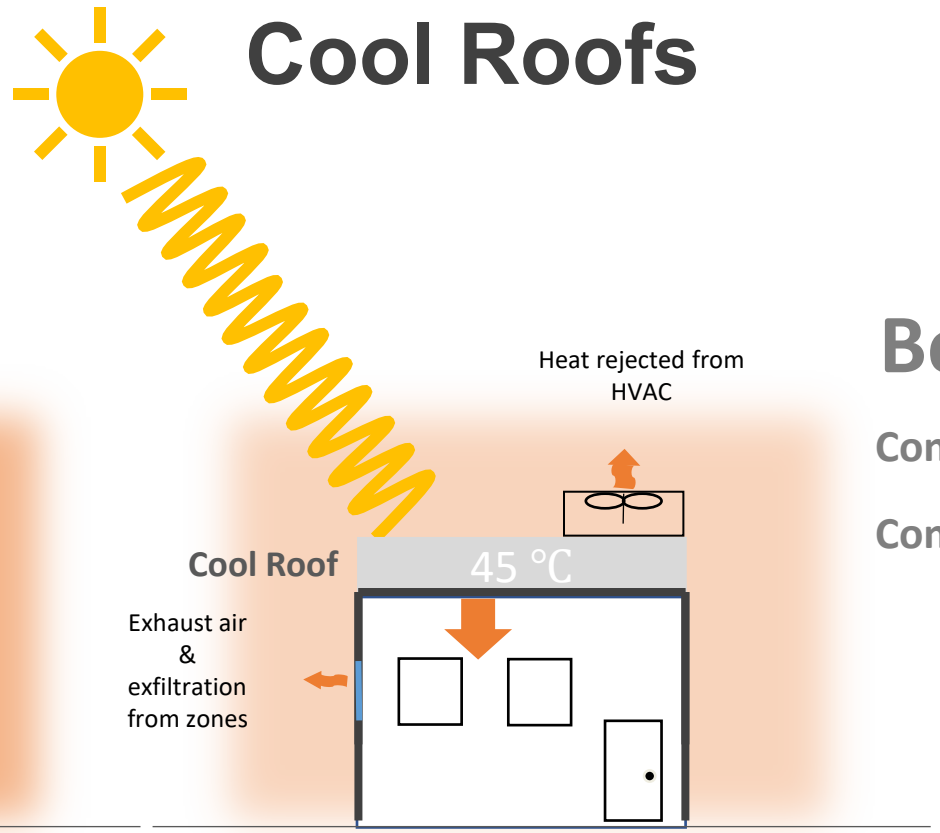
Benefits

Convective Heat ▼ ⇢ Air temp. ▼

Conductive Heat ▼

Cool Roofs





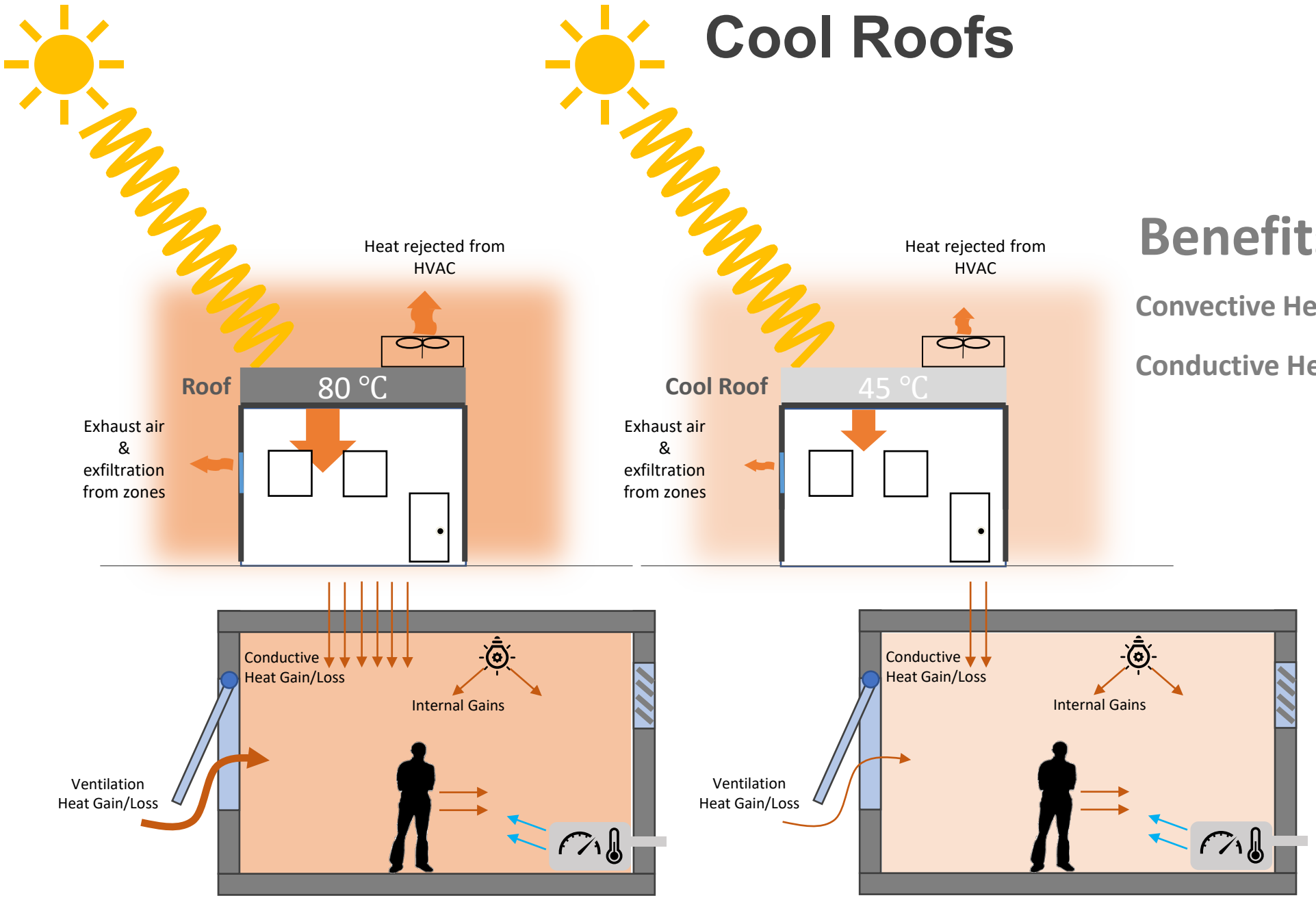
Benefits

Convective Heat ▼ ⇢ Air temp. ▼

Conductive Heat ▼ ⇢ Cooling demand ▼

⇢ Anthropogenic Heat ▼

Cool Roofs



Benefits

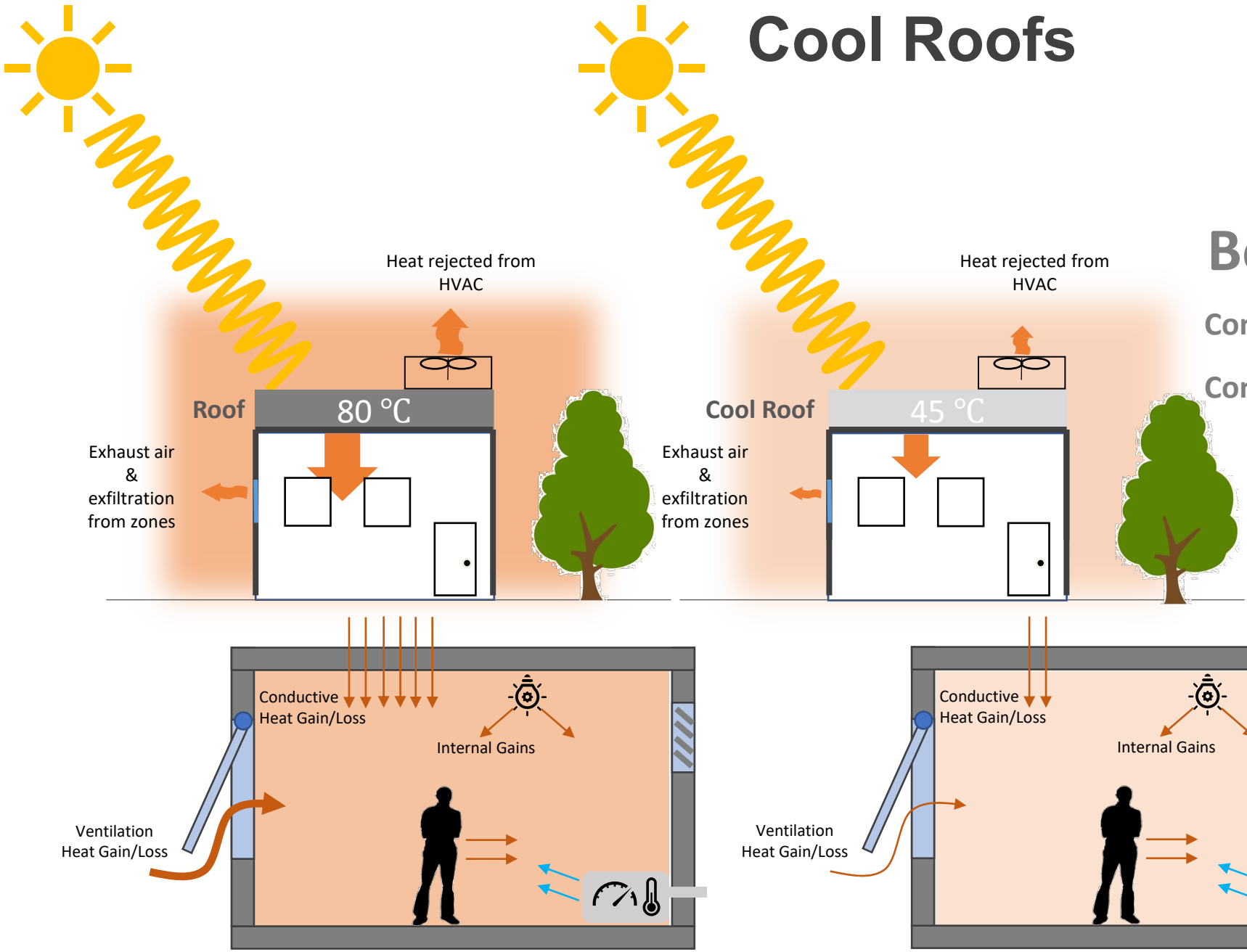
Convective Heat ▼ ⇢ Air temp. ▼

Conductive Heat ▼ ⇢ Cooling demand ▼

⇢ Anthropogenic Heat ▼

⇢ Indoor temp. ▼

Cool Roofs



Benefits

Convective Heat ▼ ⇢ Air temp. ▼

Conductive Heat ▼ ⇢ Cooling demand ▼

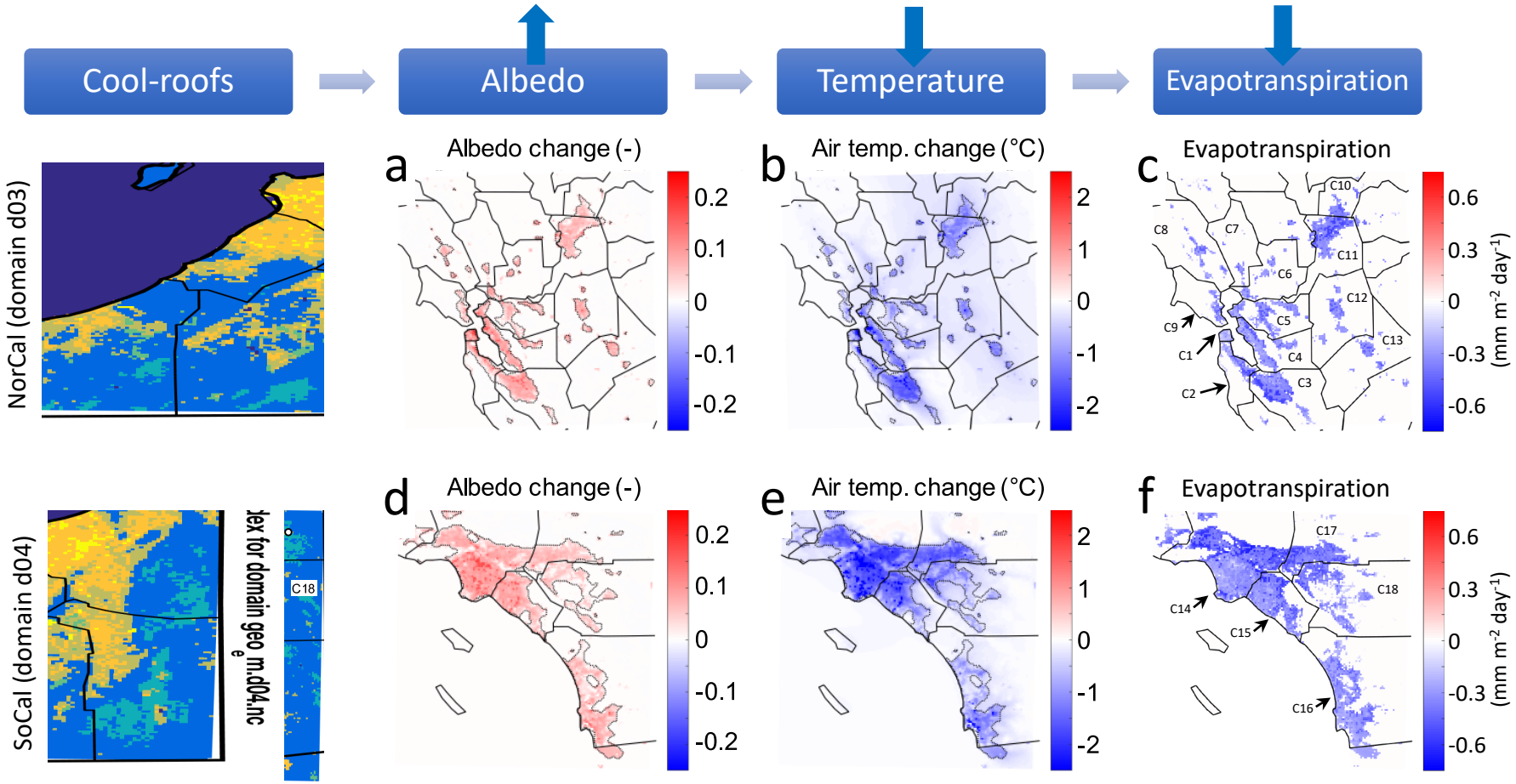
⇢ Anthropogenic Heat ▼

⇢ Indoor temp. ▼

⇢ Water demand ▼

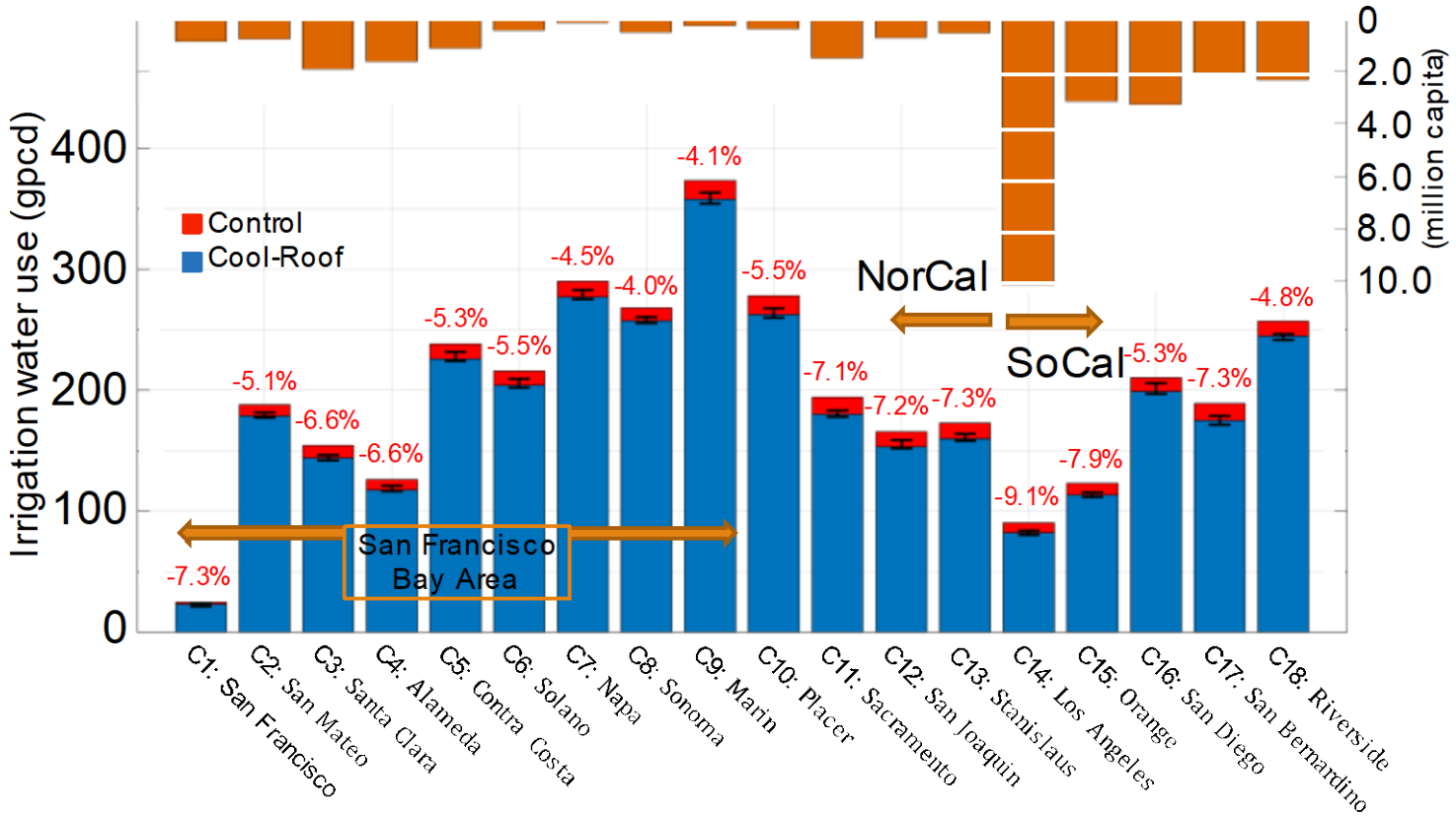
Impact of cool roofs on air temperature and evapotranspiration:

Air temperature and evapotranspiration are reduced by up to 1.5°C and 18%, respectfully.



Impact of cool roofs on outdoor water use:

Irrigation water is reduced by up to 9% as a result of cool roofs implementation across 18 studied counties.






- Energy Saving: 10-15%
- Increased Roof Life Span
- Low Cost Options: $0.15-3 per square ft

The role of trees in cooling waterwise urban landscapes

Joanna Solins

Environmental Horticulture Advisor, UC Cooperative Extension

Sacramento, Solano, and Yolo Counties

EBMUD

February 4, 2025

UC CE | UNIVERSITY OF CALIFORNIA Agriculture and Natural Resources | UC Cooperative Extension

Overview

- Effects of turf conversion & tree canopy on localized heat
- Effects of landscape irrigation on mature trees
- Cooling potential of climate-ready trees
- Strategies for turf conversion

Plants provide cooling

- Shading
  - Limits the amount of solar radiation reaching surfaces
- Transpiration
  - Plants take up water from the soil and release it into the air from their leaves
  - Surrounding air is cooled as water goes from a liquid to a vapor
- Trees outperform other types of plants

How will turf conversion affect heat?

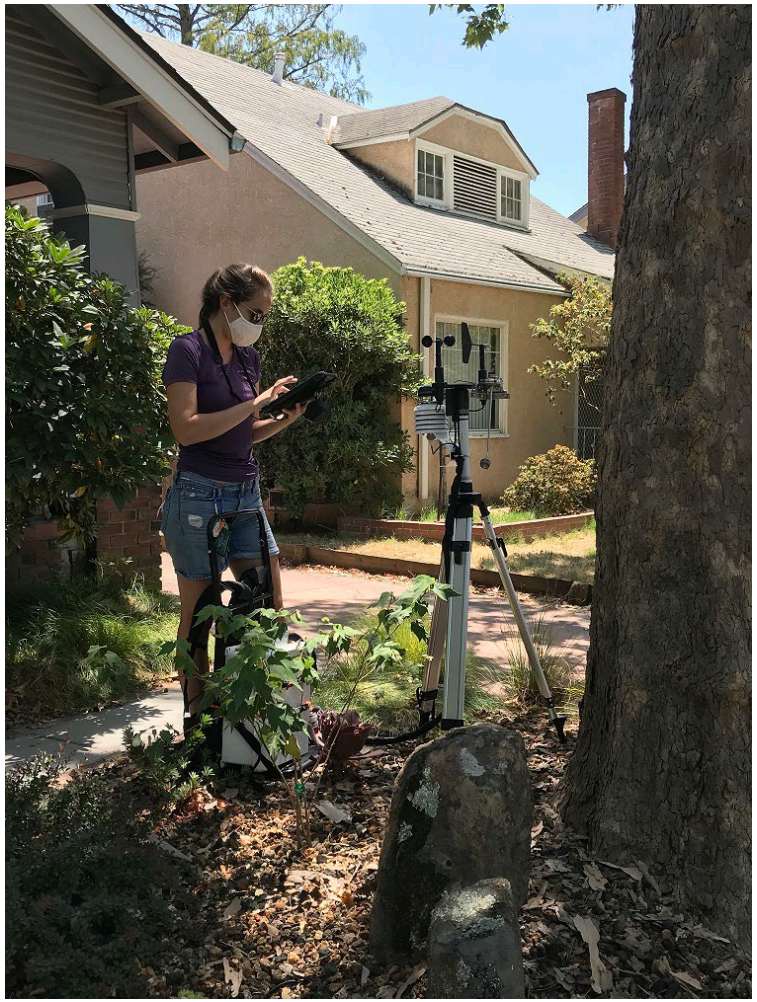
Do trees make a difference?

Lawn

Waterwise Landscaping

Source: UC Davis Arboretum and Public Garden

Extensive study: How does tree canopy affect localized heat for waterwise vs. lawn landscaping?



- Study of residential yards in Sacramento
  - 105 yards with turf lawns
  - 149 waterwise yards
- Micrometeorology measurements
  - Air temperature, relative humidity, solar radiation, wind
  - Thermal comfort indices
- Tree canopy cover
  - In the yard
  - In the neighborhood

Study led by Victoria Dearborn, Cadenasso Lab, UC Davis

Which type of yard was coolest?

Unshaded lawn

Unshaded waterwise

Shaded lawn

Shaded waterwise

Figure 6 from Dearborn 2021

Which type of yard was coolest?

Unshaded lawn

Shaded lawn

Hottest

Unshaded waterwise

Coolest

Shaded waterwise

Figure 6 from Dearborn 2021

Study take-aways

- Tree canopy improves thermal comfort substantially in waterwise yards
- Neighborhood-scale canopy cover also provided cooling
- Waterwise yards with more plants had lower air temperatures

Intensive study: How does tree canopy affect localized heat for waterwise vs. lawn landscaping?

Study led by EBMUD's Jolene Bertetto

Site 1: Lawn- Sun | Site 2: Lawn- Shade | Site 3: Garden- Sun | Site 4: Garden- Shade | Site 5: Parking lot

Figure 4, Bertetto 2022

- Courtyard in Walnut Creek
  - Same site measured intensively over the summer
  - Lawn vs. water-efficient garden area
  - Shade vs. sun
  - Vegetation Cooling Index (compared to unshaded asphalt)

Shaded waterwise landscaping has the highest cooling efficiency

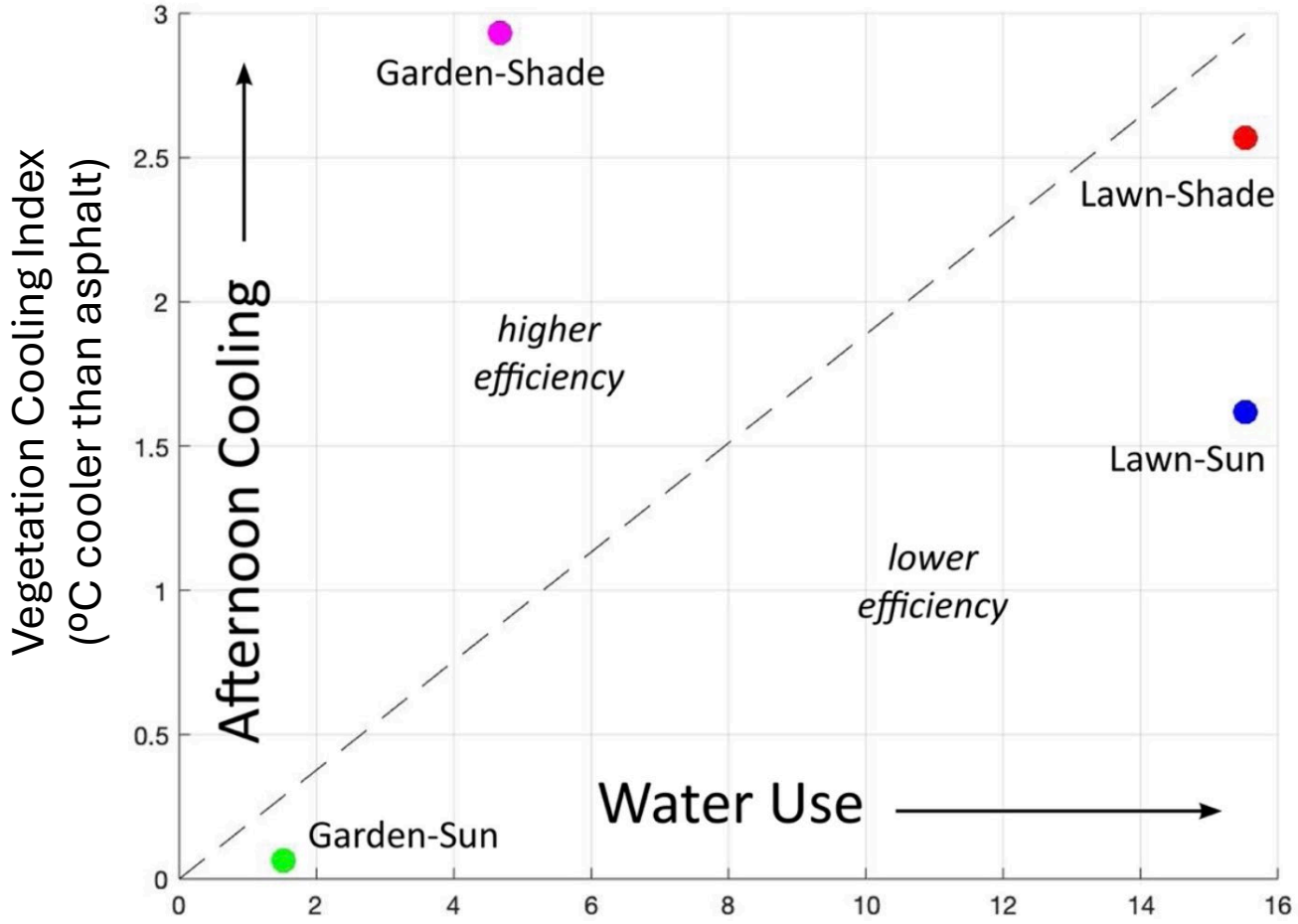


Figure 15, Bertetto 2022

Management implications

- Maintain/increase tree canopy
  - Tree canopy is key for cooling with transitions to waterwise landscaping
- Include more plants in waterwise landscaping
  - Plants can reduce temperatures compared to groundcovers like rocks and mulch

How will changes in landscaping and irrigation affect existing shade trees?

Lawn

Waterwise Landscaping

Source: UC Davis Arboretum and Public Garden

Unirrigated

Source: San Gabriel Valley Tribune

California's current urban forests were not planted to tolerate water restriction

- Statewide inventories show that most trees* have moderate to high water requirements
  - True for all size classes
  - True for all climate zones except the Southwest Desert

- Some common species:
  - London planetree (*Platanus acerifolia*)
  - Southern magnolia (*Magnolia grandiflora*)
  - Sweetgum (*Liquidambar styraciflua*)

*Datasets analyzed were mostly public, residential trees; data and water use ratings were from the Urban Forest Ecosystems Institute at Cal Poly

How does yard irrigation affect mature street trees?

London planetree
(*Platanus acerifolia*)

Water potential measurements

- 24 trees in Davis

Visual canopy health scores

- 414 trees, Davis & Sacramento

Many street trees rely on neighboring irrigation

- Most healthy
- Least stressed

- Intermediate
- Closer to lawn

- Most stressed
- Least healthy

*Lots of variation; may change over time

- Increased stress → canopy loss → reduced cooling
  - Stressed trees have less dense foliage & more dieback
  - Eventual mortality leaves large canopy gaps

Trees show legacy of past irrigation

- Trees that were historically well irrigated are less tolerant of water restriction
  - Signs of high stress and low productivity last for years after irrigation stops
  - Lower annual growth than trees that never received irrigation

- Trees that develop under water restriction are better able to cope with low-water conditions

Chin et al. 2024, *American Journal of Botany*

Tree management implications

- Maintaining current tree canopy requires higher levels of irrigation
  - Deep, less frequent irrigation is best; transition gradually when possible
  - Drip irrigation: Systems must be designed for tree needs
  - Hoses or soaker hoses

- Future urban forests may thrive with less irrigation
  - All species may be more acclimated to low-water conditions if they establish under water restriction
  - Emphasize planting trees with lower water requirements

Soaker hose around a mature tree
Source: California ReLeaf

Not all trees provide the same cooling

- Species
  - Dense, large canopies increase cooling
  - Diversity increases cooling
- Context and management
  - Greater water availability increases air cooling
  - High levels of paving can reduce transpiration and growth

Will shifting urban forests to low-water trees reduce cooling benefits?

- Climate-Ready Trees Study
  - Promising species for future conditions
  - Add diversity & resilience to CA urban forests
- Compare climate-ready trees to commonly planted urban trees
  - UC Davis reference plot (unirrigated)
  - Cannery neighborhood in Davis (irrigated)
- Determine characteristics associated with effective cooling

Maverick Mesquite
(*Prosopis glandulosa 'Maverick'*)

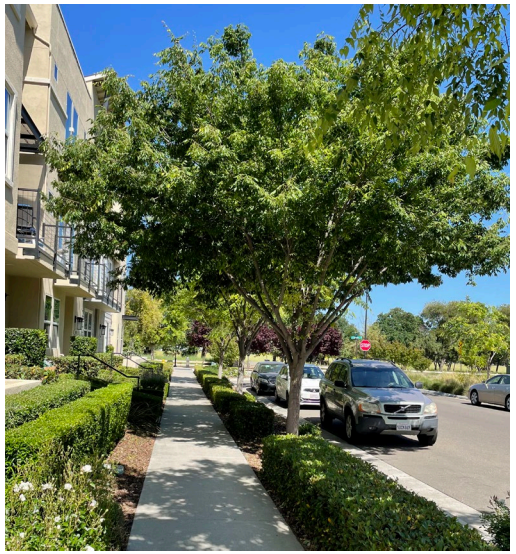
Funded by The Britton Fund

Monthly field measurements (May-Sept)

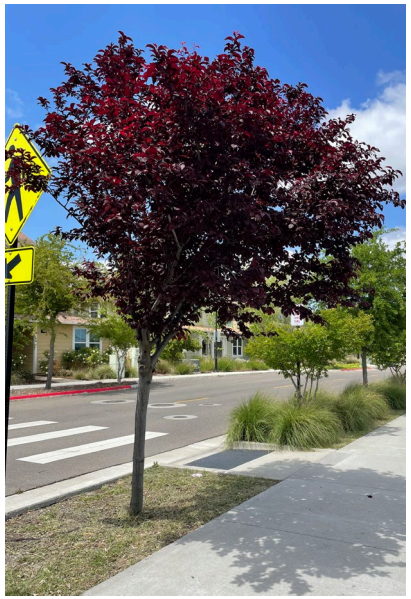
- Ground surface temperature
- Wet bulb globe temperature
  - Thermal comfort indicator
  - Temperature, humidity, solar radiation, wind
- Light interception
- Canopy and leaf traits

Trees with **wide, dense** canopies provide the most cooling

Common street trees ⟺ Climate-ready trees



Village Green Zelkova
(*Zelkova serrata* '*Village Green*')

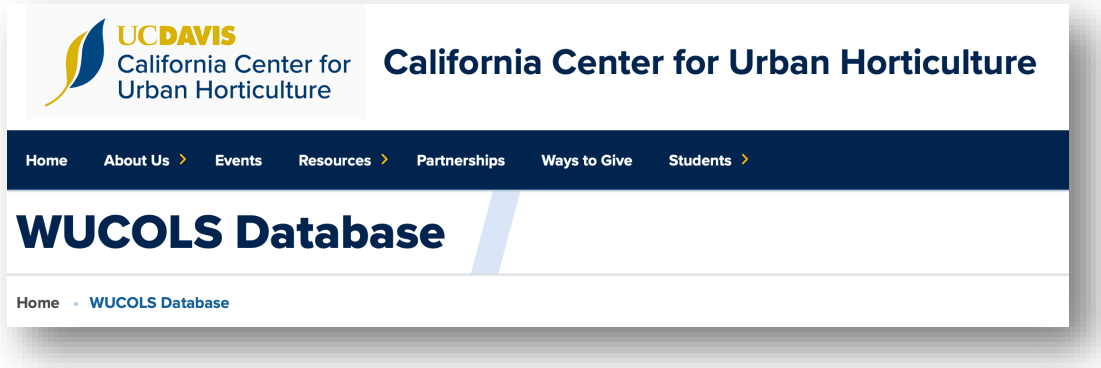


Cherry Plum
(*Prunus cerasifera*)

Canby's Oak
(*Quercus canbyi*)

Emerald Sunshine Elm
(*Ulmus propinqua* '*JFS-Bieberich*')

Tree selection resources:



https://ccuh.ucdavis.edu/wucols-db

https://selectree.calpoly.edu

- Water use ratings by region
- Lacks some tree species/cultivars
- Narrative description

- One water use rating per species
- Many species
- Lots of information; search filtering

Turf conversion research

What methods are most effective?

How will they affect mature trees?

Huge thanks to Sacramento County Regional Parks for installing the treatments!

Wrapping up

- Trees & other plants can mitigate heat impacts of lawn conversion
  - With adequate shading, waterwise landscaping can be cooler than lawns
  - Living groundcover plants also help with cooling
- Maintaining tree canopy requires irrigation
  - Consider current tree water needs in conversions
  - Choose species that provide ample shading with less water
- Environmental justice implications
  - Tree canopy and heat are already inequitably distributed
  - Landscape transitions that preserve cooling require resources

Landscape professionals:

Please take a survey for UC Cooperative Extension!

In English

En español

https://ucanr.edu/sites/landscape_professionals

Thank you!

Thank you

Research funding:

The Britton Fund, California State Water Resources Control Board

Research collaborators:

Street trees: Mary Cadenasso, Erik Porse, Bogumila Backiel

Climate-Ready Trees: Alison Berry, Natalie van Doorn, Mickie Tang, Matthew Gilbert

Turf conversion: Karey Windbiel-Rojas, Chris Shogren, Judy McClure, Mary Cadenasso, Yan Yan, Sarah Light

Special thanks:

Ron Nelson, David Dugan (Sacramento County Regional Parks)

Master Gardeners (UCCE)

Matthew Ritter, G. Andrew Fricker, Natalie Love (Cal Poly SLO)

Charlotte Ely, Karina Herrera, Marielle Pinheiro (California State Water Resources Control Board)

Contact: jsolins@ucanr.edu

Summary

- State water conservation policies outline an increase of indoor and outdoor water use efficiency over time.
- The ban on irrigating commercial non-functional turf with potable water has a tiered timeline, starting with municipal properties in 2027.
- Based on recent studies
  - Replacing lawns with low water plants, ground covers, and a diversity of trees helps to reduce localized heat.
  - Cool roofs have shown to reduce irrigation demand of the surrounding landscape.
  - Recommended to put trees on a separate hydrozone to match irrigation requirements for established and new trees.
- Train landscape team to care for new landscapes.
- Take advantage of EBMUD rebates and resources.

Thank you!

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Creating a Conservation Culture

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