

# Overview of Federal, State, and Local Efforts to Reduce Heat Islands in the U.S.

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Cool Roof Rating Council Annual General Membership Meeting

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Las Vegas, Nevada



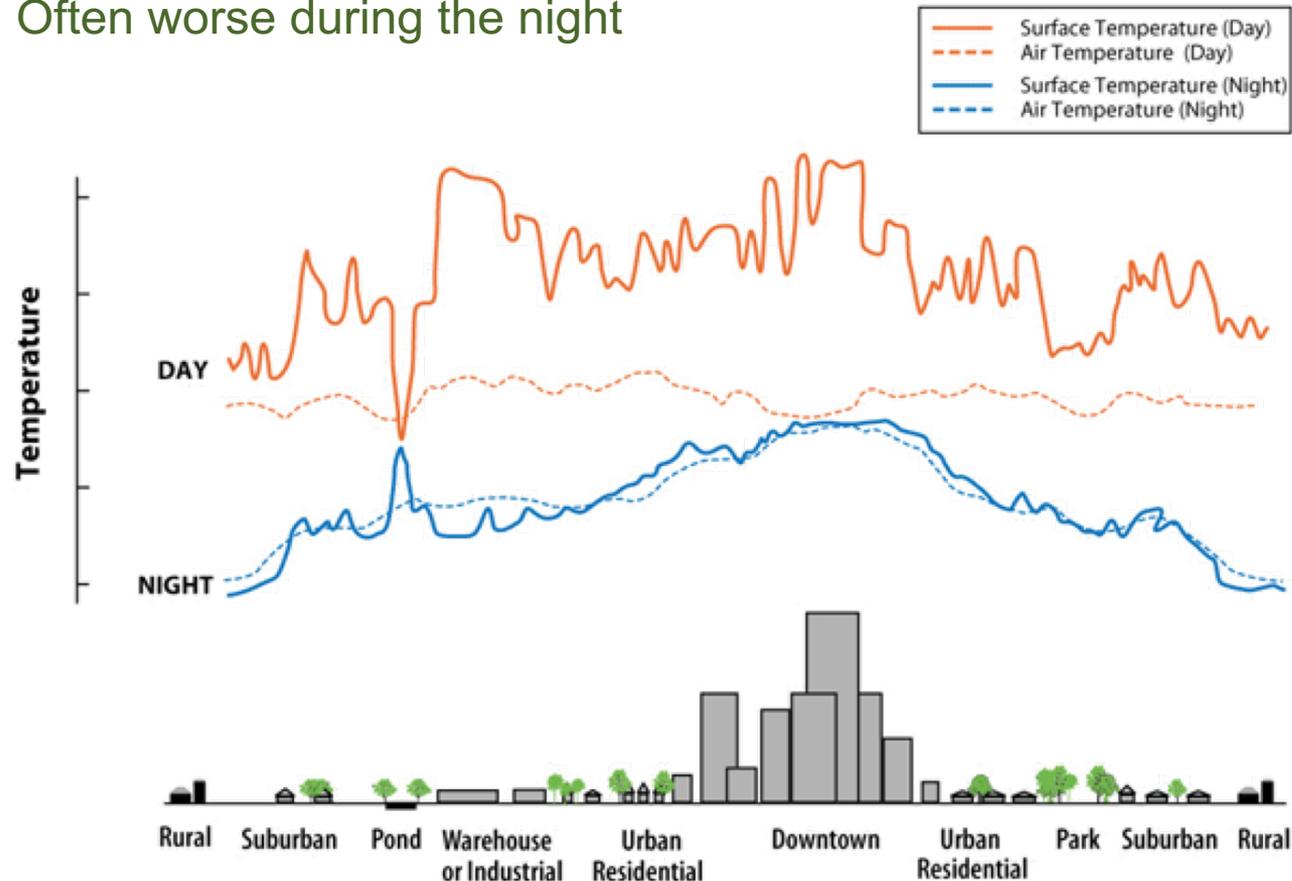


# Agenda

- Overview of the Heat Island Effect
    - Causes
    - Impacts
  - Co-Benefits of Cool Roofs
  - Local Cool Roof Policy Examples
  - Heat Island Reduction Program Resources
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# Overview of the Heat Island Effect

- Micro-scale temperature differences between urban and rural areas
- Urban area temperatures can be significantly higher than rural areas
- Often worse during the night





# Heat Island Effect Strengthening

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- The U.S. Global Change Research Program issued a [key finding](#) in its 2017 special report that it projects with high confidence that the heat island effect in the U.S. will strengthen in the future

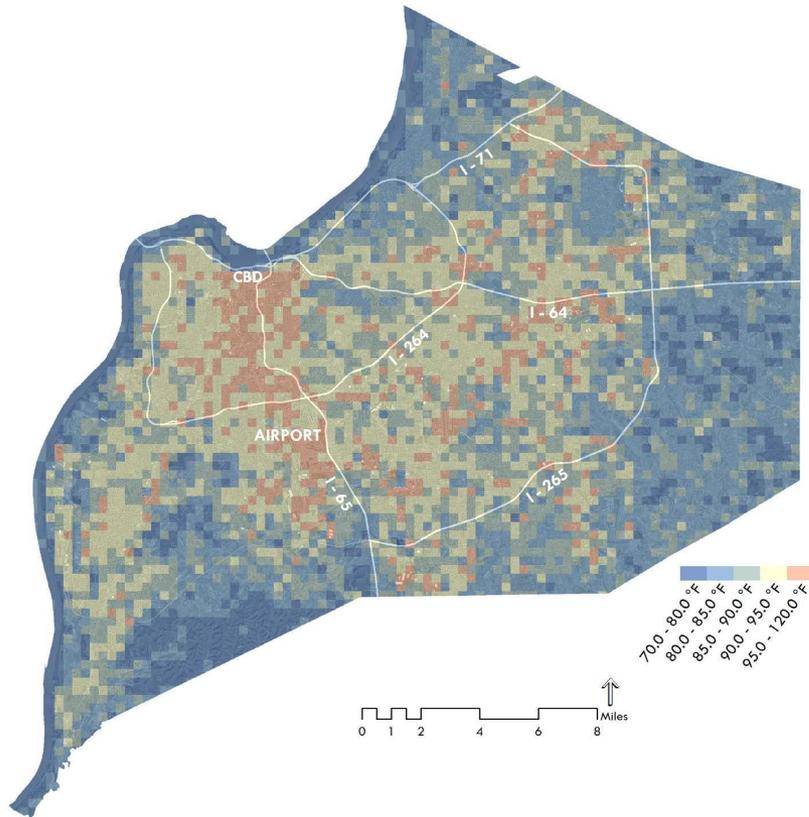


*“In the United States, this urban heat island effect results in daytime temperatures 0.9°–7.2°F (0.5°–4.0°C) higher and nighttime temperatures 1.8°– 4.5°F (1.0°–2.5°C) higher in urban areas, with larger temperature differences in humid regions (primarily in the eastern United States) and in cities with larger and denser populations.”*



# Citywide Heat Island Mapping

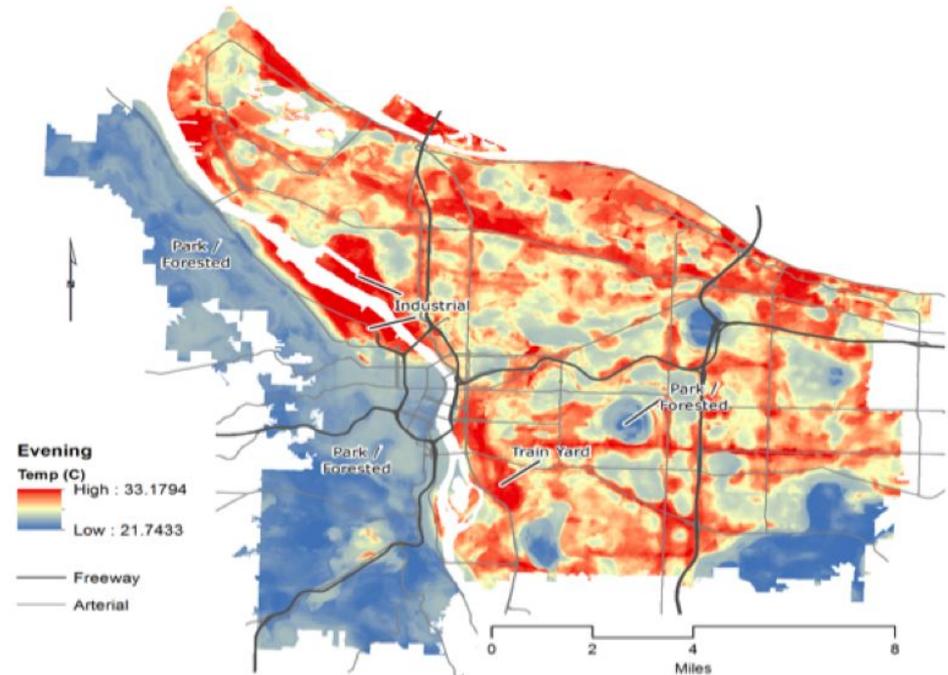
## Louisville Modeling



**Distribution of surface temperatures in Louisville**

[Louisville Urban Heat Management Study](#)

## Portland Measurement



**Portland Temperatures on a hot day in 2014**

[Hot or Not?](#)

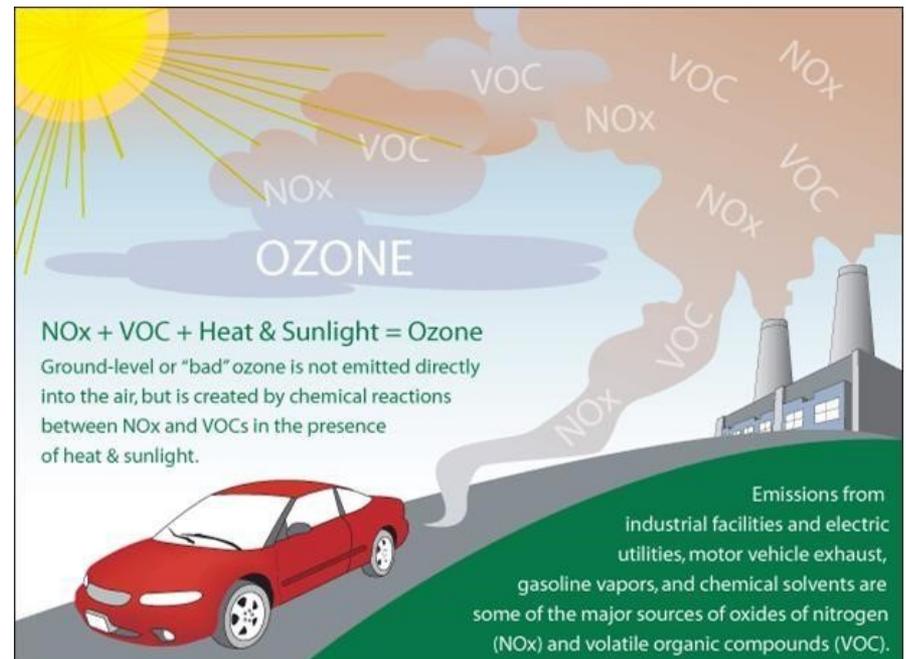
# What Causes Heat Islands to Form?

- Reduced vegetation
- Urban geometry (dense development)
- Materials used to build urban infrastructure (impermeable, heat absorbing)
- Generation of waste heat (e.g., air conditioners, cars)



# Heat Island Impacts

- Higher energy consumption (and emissions of greenhouse gas emissions and criteria pollutants)
- Reduced air quality
- Reduced water quality
- Higher risks to public health





# Heat Island Impacts



## ■ Energy use

- Among cities with heat islands, 5-10% of summertime electricity demand is used to compensate for the heat island effect
- 1.5 – 2.0% E demand ↑ for every 1°F ↑ in the summer
- Longer peak periods; pressure on E grid; brownouts, blackouts



## ■ Air quality and carbon pollution

- Increased greenhouse emissions (climate change)
- Increased air pollution
- Increased ground-level ozone formation



## ■ Water quality

- Warmer water runoff = ecological shock in waterways
- Increased water runoff = more pollutants in waterways

## ■ Human health

- Respiratory problems, heat cramps, heat exhaustion, heat stroke/sun stroke, mortality
- Among most deadly weather-related events in a given year
- 658 annual heat-related deaths on average in U.S.

# Who is Most Vulnerable?

- Lower temperatures provide direct benefits to vulnerable populations:
  - Older adults
  - Young children
  - People with lower incomes
  - Outdoor workers
  - People with compromised health
  
- Indirect health benefits include better air quality due to reduced ozone formation
  - More than 9% of U.S. children and nearly 8% of older adults aged 65-75 currently have asthma. Exposure to ozone can exacerbate asthma.



# Mitigation Co-benefits



# Mitigation Strategies

Communities can reduce ambient air and surface temperatures while achieving many other environmental benefits by taking these common sense actions:

- Trees and Vegetation
- Green Roofs
- **Cool Roofs**
- **Cool Pavements**
- Smart Growth



# Mitigation Strategy Co-benefits

Green Roofs



Trees and Vegetation



Cool Pavement



Cool Roofs



Air quality



Energy use



Greenhouse gas emissions



Human health and comfort



Nighttime visibility



Quality of life



Safety



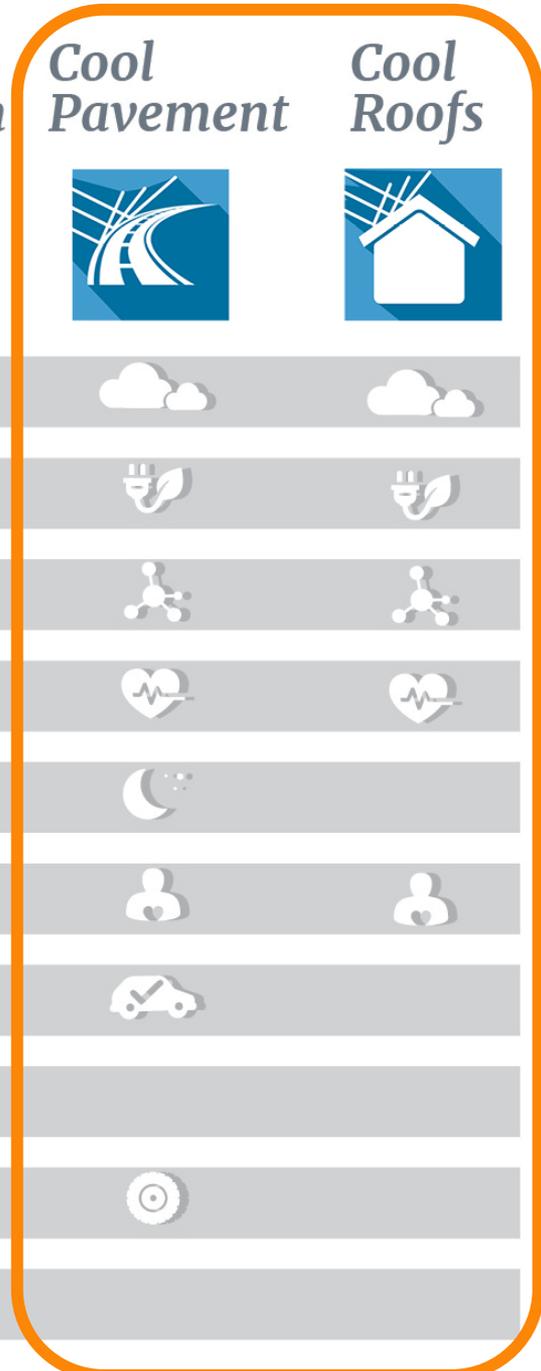
Stormwater management



Tire noise



Water quality



# Mitigation Strategy: Cool Roofs

## Multiple Benefits

- Heat island mitigation: increased reflectance and thermal emittance
- Energy savings from decreased A/C demand
- Improved air quality and lower greenhouse gas emissions (through reduced energy use)
- More comfortable and healthier indoor environments



**Economics:** Annual net savings of 50¢/foot<sup>2</sup> in some climates (based on California study).



# Mitigation Strategy: Cool Roofs

## Recent Research

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- [The impact of heat mitigation strategies on the energy balance of a neighborhood in Los Angeles.](#) Taleghani et al. 2019
  - [Monitoring the Urban Heat Island Effect and the Efficacy of Future Countermeasures.](#) Levinson et al. 2019.
  - [Preparatory meteorological modeling and theoretical analysis for a neighborhood-scale cool roof demonstration.](#) Millstein and Levinson. 2018.
  - [Systematic Comparison of the Influence of Cool Wall versus Cool Roof Adoption on Urban Climate in the Los Angeles Basin.](#) Zhang et al. 2018
  - [Energy and environmental consequences of a cool pavement campaign.](#) Gilbert et al. 2017.
  - [Are Cooler Surfaces a Cost-Effect Mitigation of Urban Heat Islands?](#) Pomerantz. 2017.
  - [Next-Generation Factory-Produced Cool Asphalt Shingles: Phase 1 Final Report.](#) Levinson et al. 2016.
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# Cool Roofs vs. Green Roofs

## Cool Roofs

- Highly reflective and emissive materials
- Lower up-front cost
- Benefits:
  - Lower surface temp.
  - Lower air temp.
  - Energy savings



## Green Roofs

- Vegetative layer grown on a rooftop
- Higher up-front cost
- Benefits:
  - Lower surface temp.
  - Lower air temp.
  - Energy savings
  - Longer roof life
  - Reduce stormwater runoff
  - Filter stormwater runoff
  - Absorb air pollutants and carbon dioxide
  - Provide natural habitat
  - Recreation space

# Local Government Policy Landscape



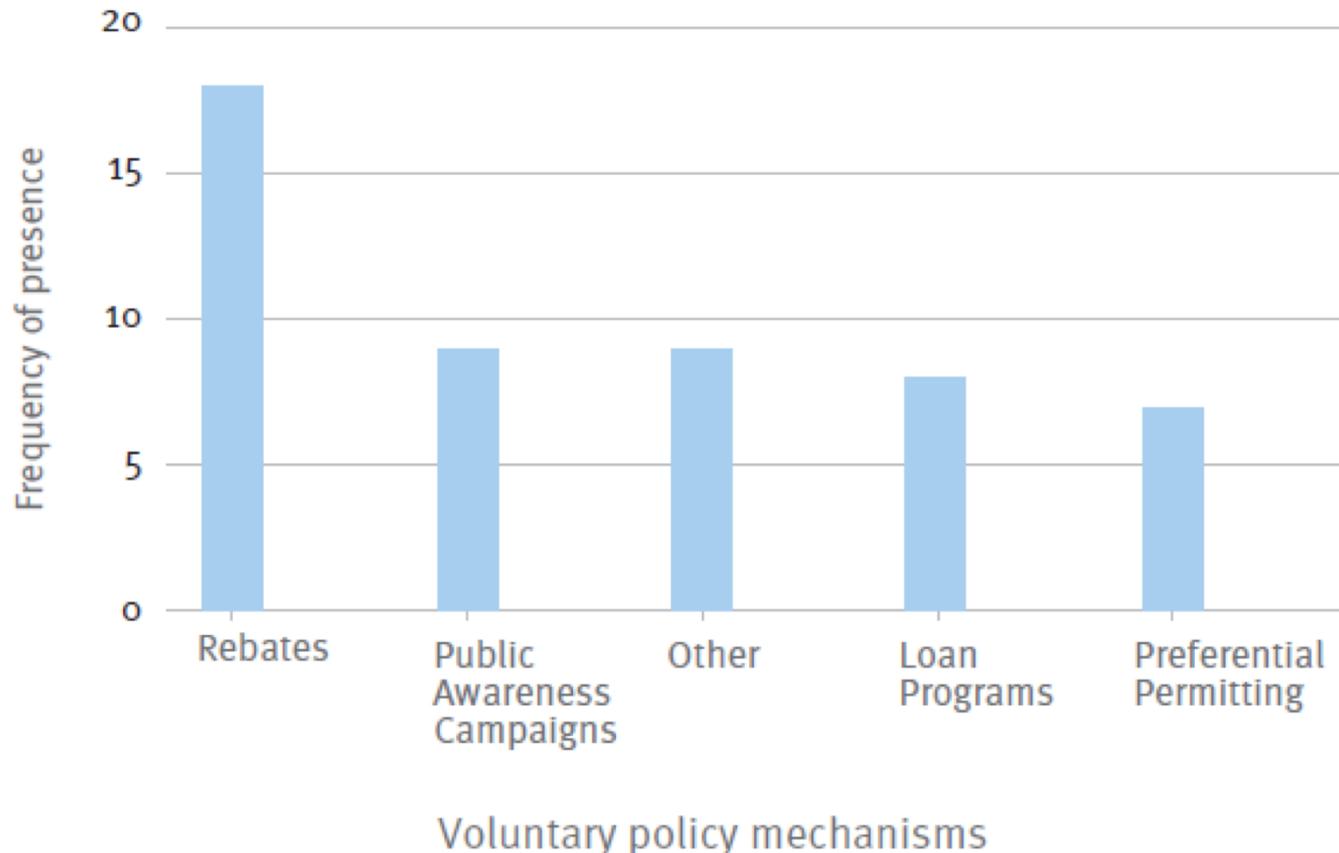
# Voluntary Mechanisms

- Demonstration projects
- Incentive programs
- Urban forestry and community tree planting programs
- Weatherization
- Outreach and education
- Awards



# Local Government Actions to Reduce Heat Islands

- Prevalence of voluntary policies to encourage private investment in cool technologies



# San Antonio, TX

- Under 1 Roof: Residential cool roof repair program
- Targeted to lower-income homeowners in certain districts
- FREE to homeowners if they meet criteria
- 175 energy efficient roofs have been installed so far
- \$2.95 Million has been allocated to the program since October 2015
- Monitoring with University of Texas at San Antonio
- Average reduction in Energy Use Intensity is 7.3%



Featured on August 2018 webinar:

[www.epa.gov/heat-islands/heat-island-webcasts](http://www.epa.gov/heat-islands/heat-island-webcasts)



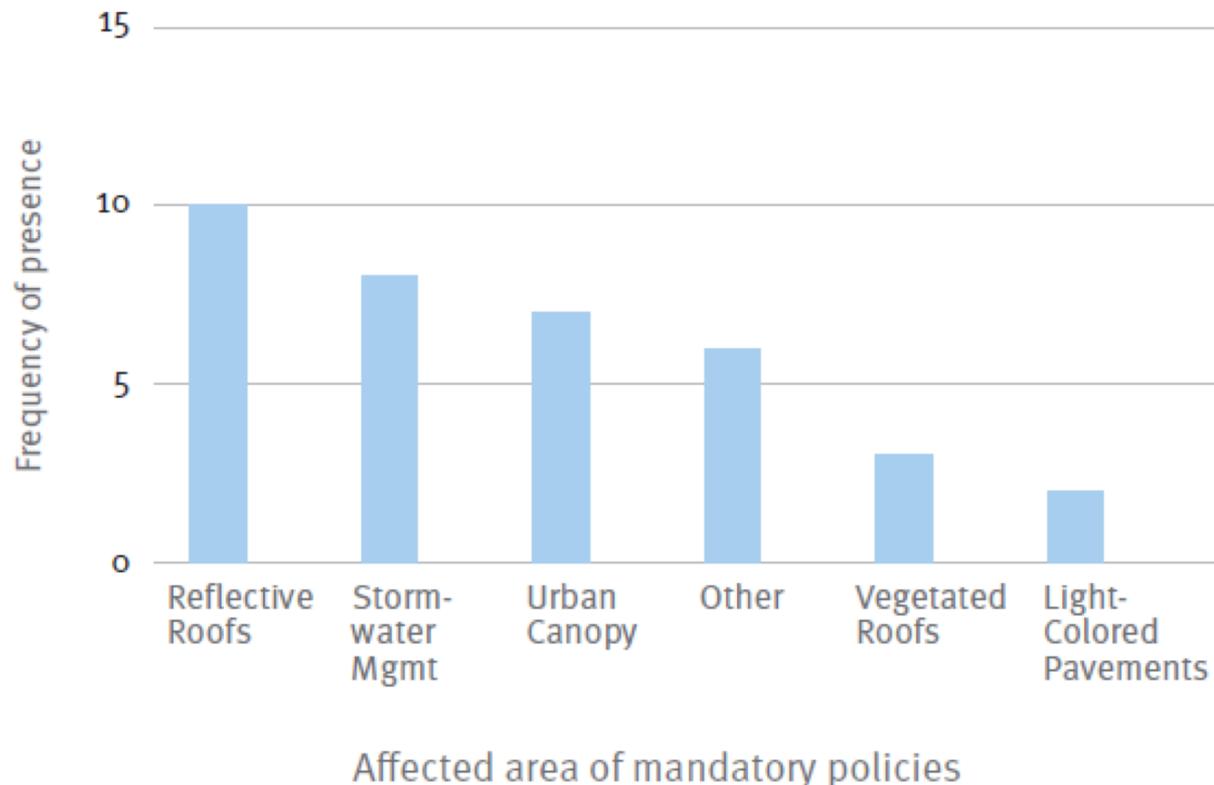
# Policy Mechanisms

- Procurement
- Resolutions
- Tree and landscape ordinances
- Comprehensive plans and design guidelines
- Zoning codes
- Green building programs and standards
- Building codes
- Air quality requirements



# Local Government Actions to Reduce Heat Islands

- Prevalence of mandatory policies for private-sector construction and management



# Los Angeles, CA



- Cool roof residential rebate: October 2010
- Code requirement: January 2015
  - Roof repair or replacement > 50%
- Provisions for solar reflectance and thermal emittance
- Featured on September 2018 webinar:
  - [www.epa.gov/heat-islands/heat-island-webcasts](http://www.epa.gov/heat-islands/heat-island-webcasts)

## Results

- 2,200 rebates:  $\approx 7$  million ft<sup>2</sup>, saving over 1.5 GWh/yr
- 18,000 permitted roofs:  $\approx 26$  million ft<sup>2</sup>, saving over 3.6 GWh/yr
- Market transformation
  - Manufacturers adjusting product offerings
  - Expect effects on non-permitted roofs and other local jurisdictions

# Denver, CO



- Nov 2017 green roof ballot measure for buildings 25,000 ft<sup>2</sup> or larger
- Ballot measure not feasible as drafted
- Consensus-building process to honor the vote
- Flexibility in roof options. Cool roof PLUS:
  - Green roof or green space
  - Green roof plus solar or energy efficiency
  - Solar or energy efficiency
  - Building certification (e.g., LEED)
- Will be featured on July 2019 webinar:
  - <https://epawebconferencing.acms.com/greeninitiatives/event/registration.htm>

# Heat Island Reduction Program Resources





# Program Overview



## ■ Mission

The EPA Heat Island Reduction Program works to create sustainable and comfortable communities by promoting state and local programs and policies that include heat island reduction measures.



## ■ Heat Island Community

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- Local and state policymakers and program implementers
  - Academia/researchers
  - Other federal agencies
  - Non-profit organizations
  - Industry



# Heat Island Program Resources

- **Compendium of Strategies:** Heat island science, detailed info on mitigation strategies, local examples, policy options
- **Website:** Basic information on heat island topics, calendar of events, newsroom, links to other resources
- **Examples:** Database of more than 75 local and statewide initiatives to reduce heat islands
- **Webcasts:** Topics include local case studies, public health concerns, advances in mitigation strategies
- **Newsletter:** Includes recent news on local activities, research updates, funding opportunities

[www.epa.gov/heat-islands](http://www.epa.gov/heat-islands)





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