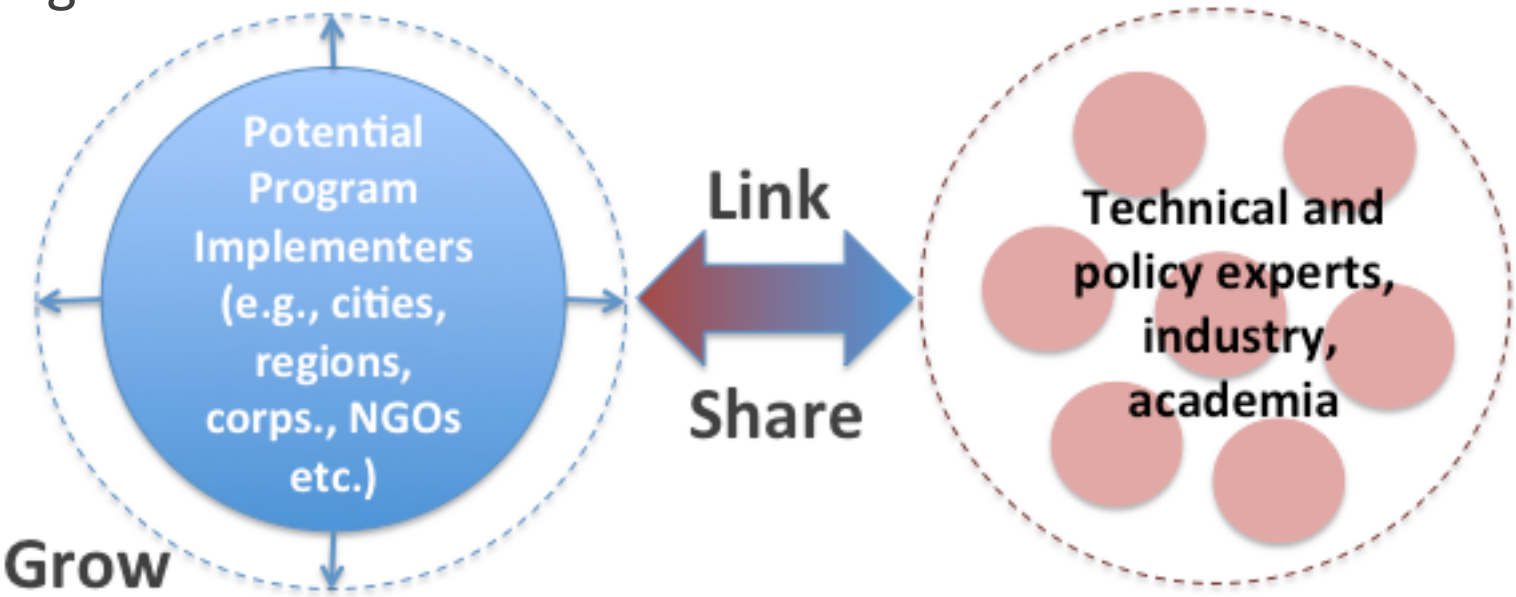
The Cool Surfaces Opportunity in Los Angeles

Global Cool Cities ALLIANCE

Global Cool Cities Alliance (GCCA)

The Global Cool Cities Alliance is dedicated to advancing policies and actions that increase the solar reflectance of our buildings and pavements as a cost-effective way to promote cool buildings, cool cities, and to mitigate the effects of climate change through global cooling.



Board

Hashem Akbari – Concordia University

Dian Grueneich – Dian Grueneich Consulting (former CPUC Commissioner)

Catherine Hunt – Dow Corporation

Gregory Kats – Good Energies

Laurie Kerr – NRDC (former Deputy Director for Energy Efficiency for New York City)

Ronnen Levinson - LBNL

Art Rosenfeld – LBNL, former CA Energy Commissioner

Stephen Wiel – Collaborative Labeling and Appliance Standards Program

John Wilson – Energy Foundation

Staff

Kurt Shickman – Executive Director

Washington, DC

Amy Dickie – Deputy Director

San Francisco, CA

Global Cool Cities ALLIANCE

Global and Urban Heat Trends

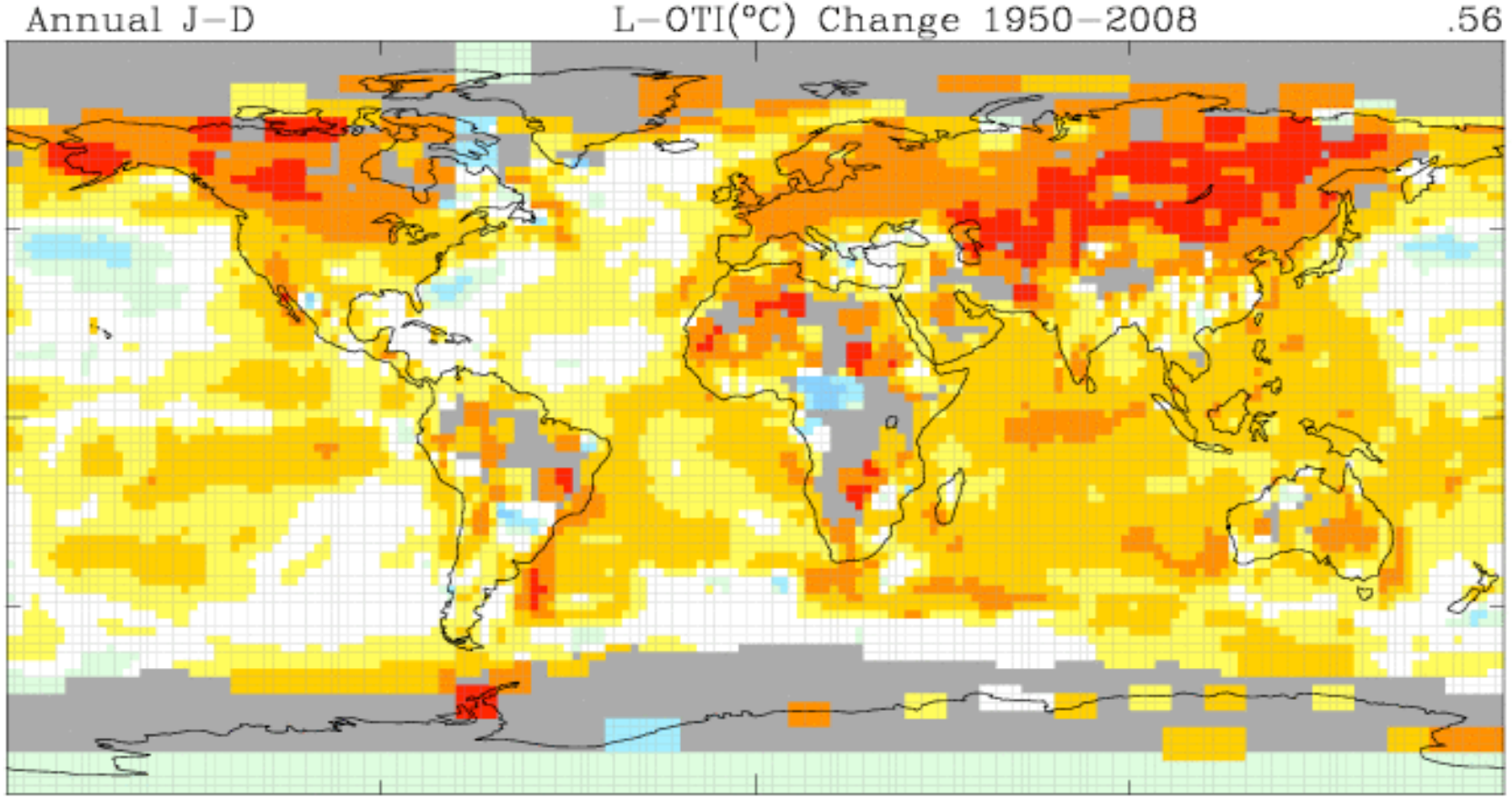
The Problems of Excess Urban Heat

How Cool Surfaces Work

Benefits

Urban Heat Island Mitigation Strategies

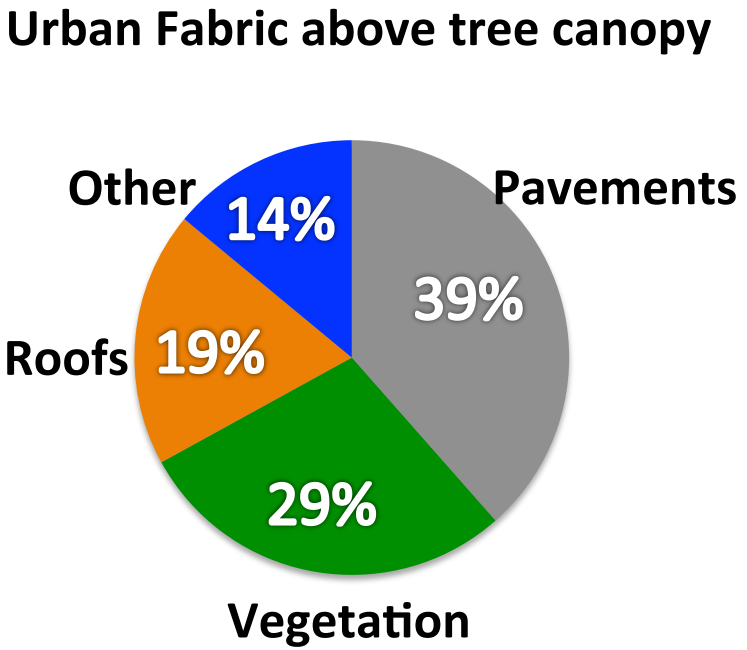
The planet is warming (~1°C over the last century)



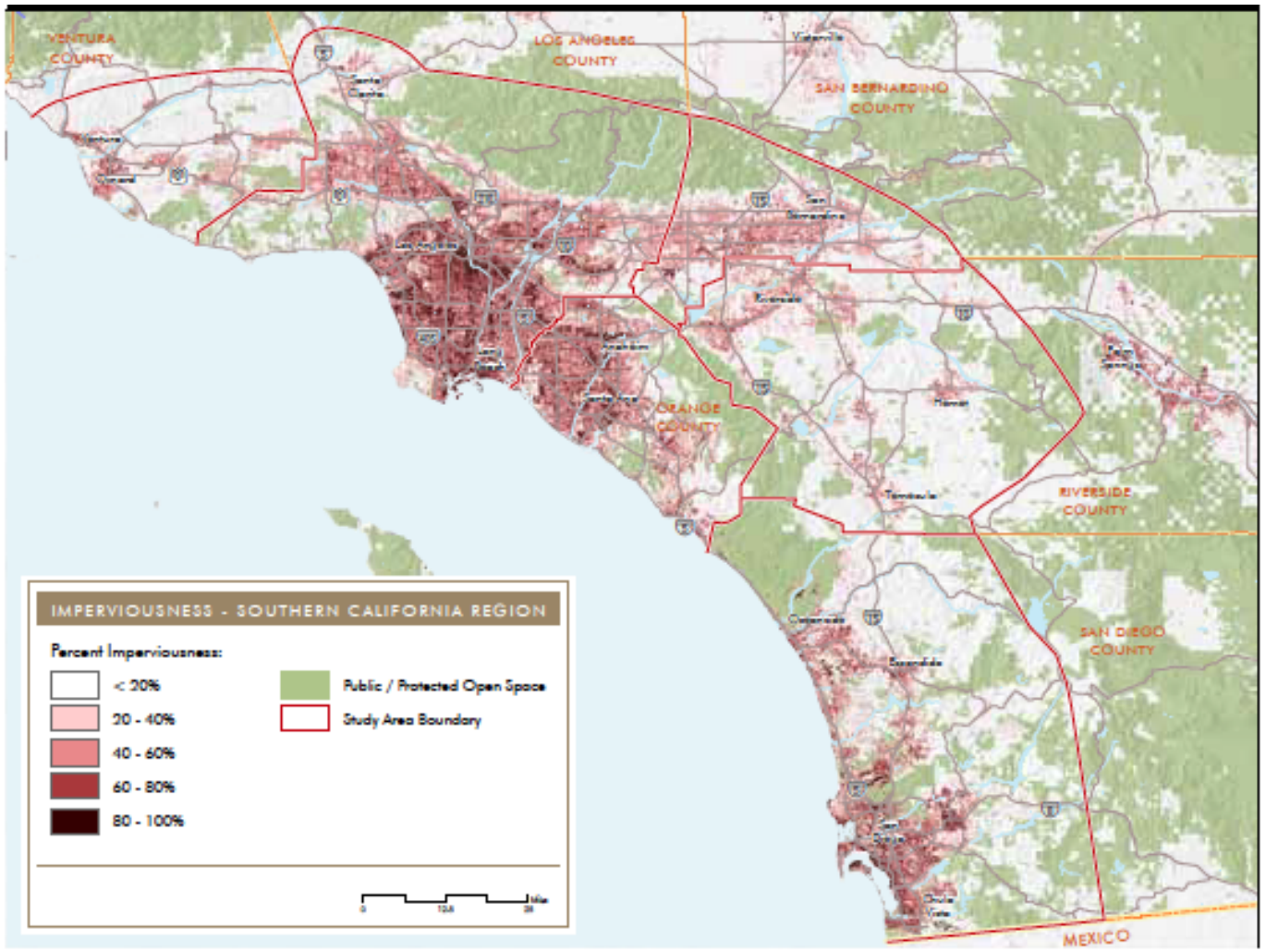
Source: NASA

Cities are especially hot, thanks to the urban heat island effect

- Human activity, combined with dark roofs and pavements, make cities hotter than surrounding rural areas.
- Higher temperatures lead to greater energy use, lower air quality, and a reduced quality of life in urban areas.

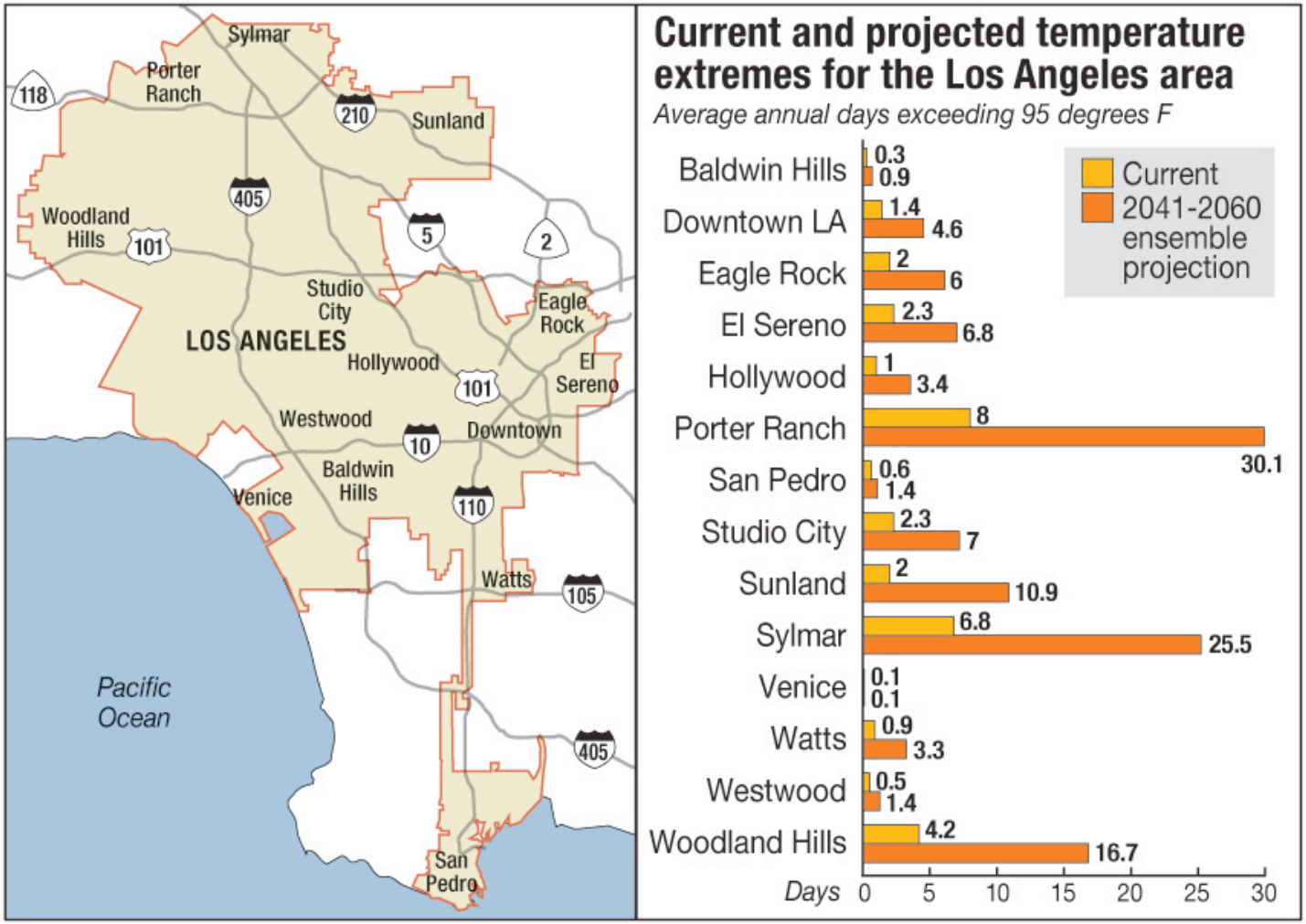


Impervious surfaces in Los Angeles



Source: NRDC "Clear Blue Future," 2009.

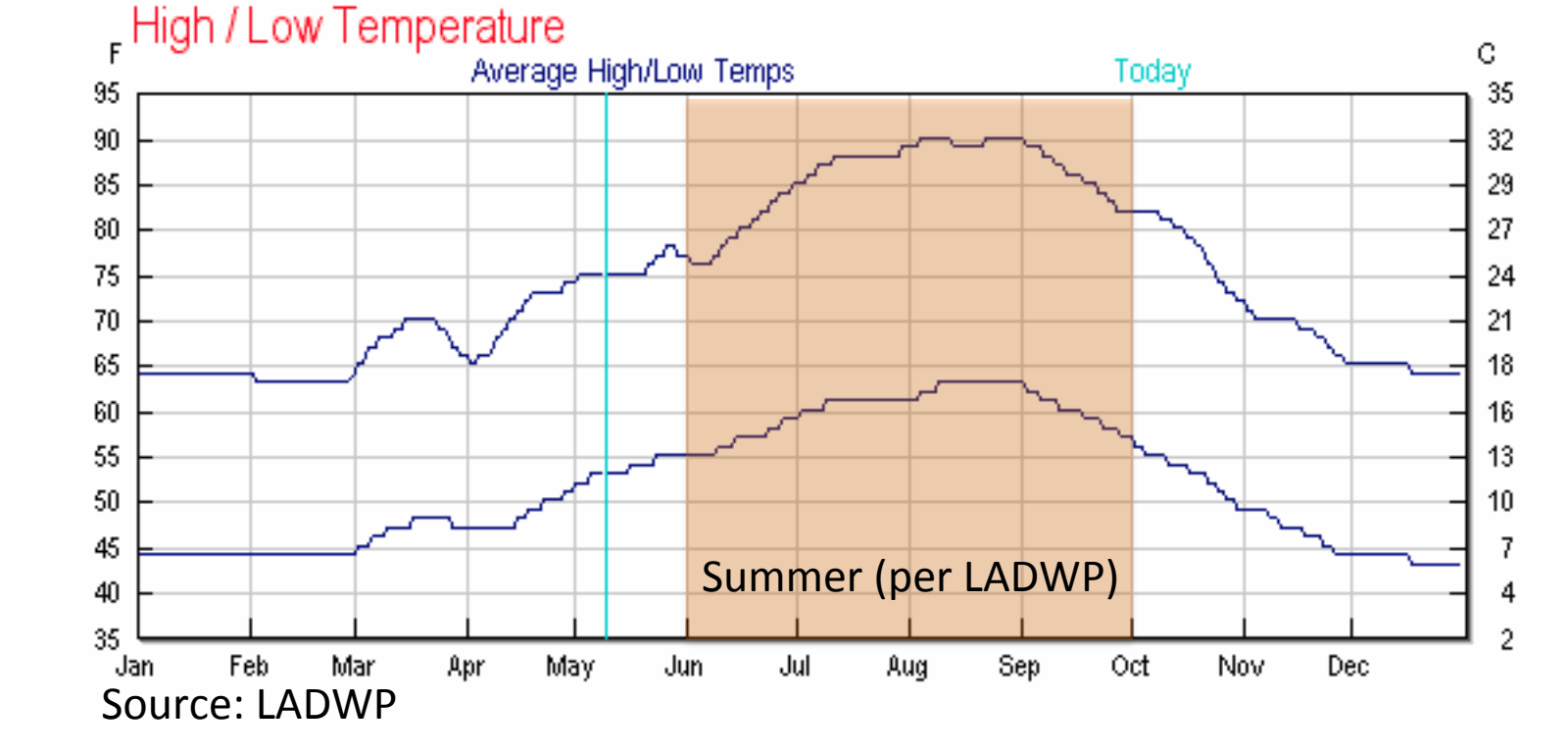
Heat trends in Los Angeles



By 2041 – 2060: *Average temperature increase of 4.6° F (over land). Tripling of "extreme heat days."*

Source: UCLA LARC study, 2012; chart based on the mean/average projected by the 19 climate models

Avg. temperatures in Los Angeles



Source: LADWP

Los Angeles temperatures rise approximately 0.5 C each decade, adding about 250 megawatts of cooling load to the city

Global and Urban Heat Trends

The Problem with Excess Urban Heat

How Cool Surfaces Work

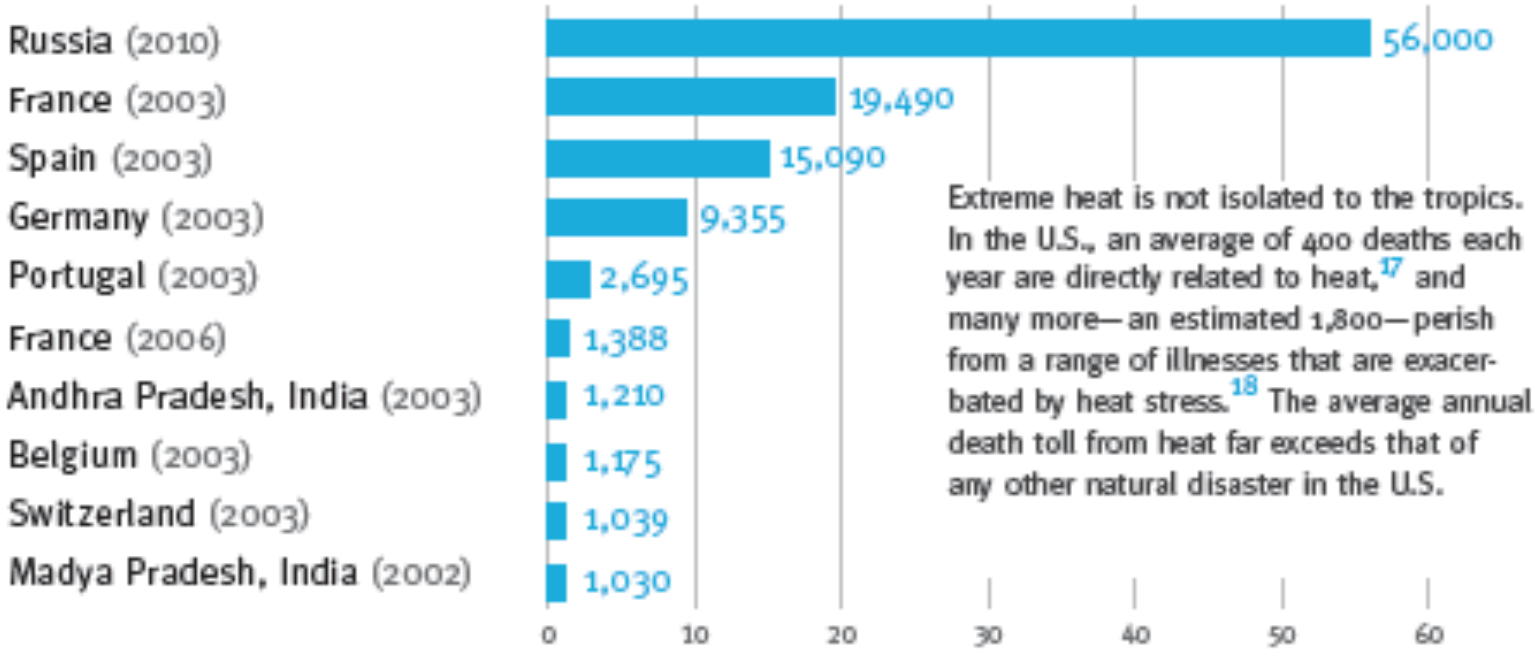
Benefits

Urban Heat Island Mitigation Strategies

Temperature disaster trends

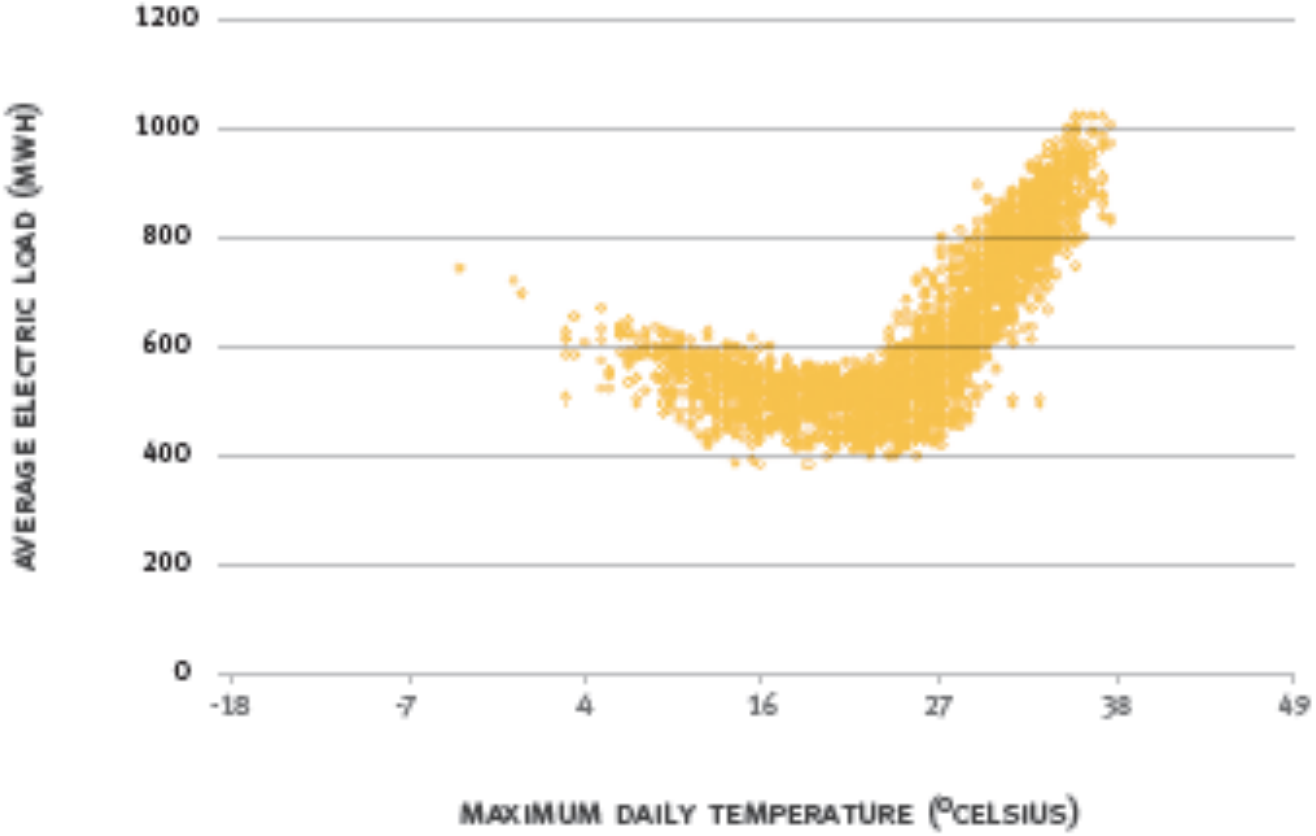
Ten Most Deadly Heat Events

Events are listed by country and year with the number of deaths shown in thousands.
Source: EM-DAT: The OFDA/CRED International Disaster Database. 2007. Available at em-dat.net, Université Catholique de Louvain, Brussels, Belgium. Data downloaded on 20 September 2007.



Source: EM-DAT: The OFDA CRED International Disaster Database and World Resources Institute

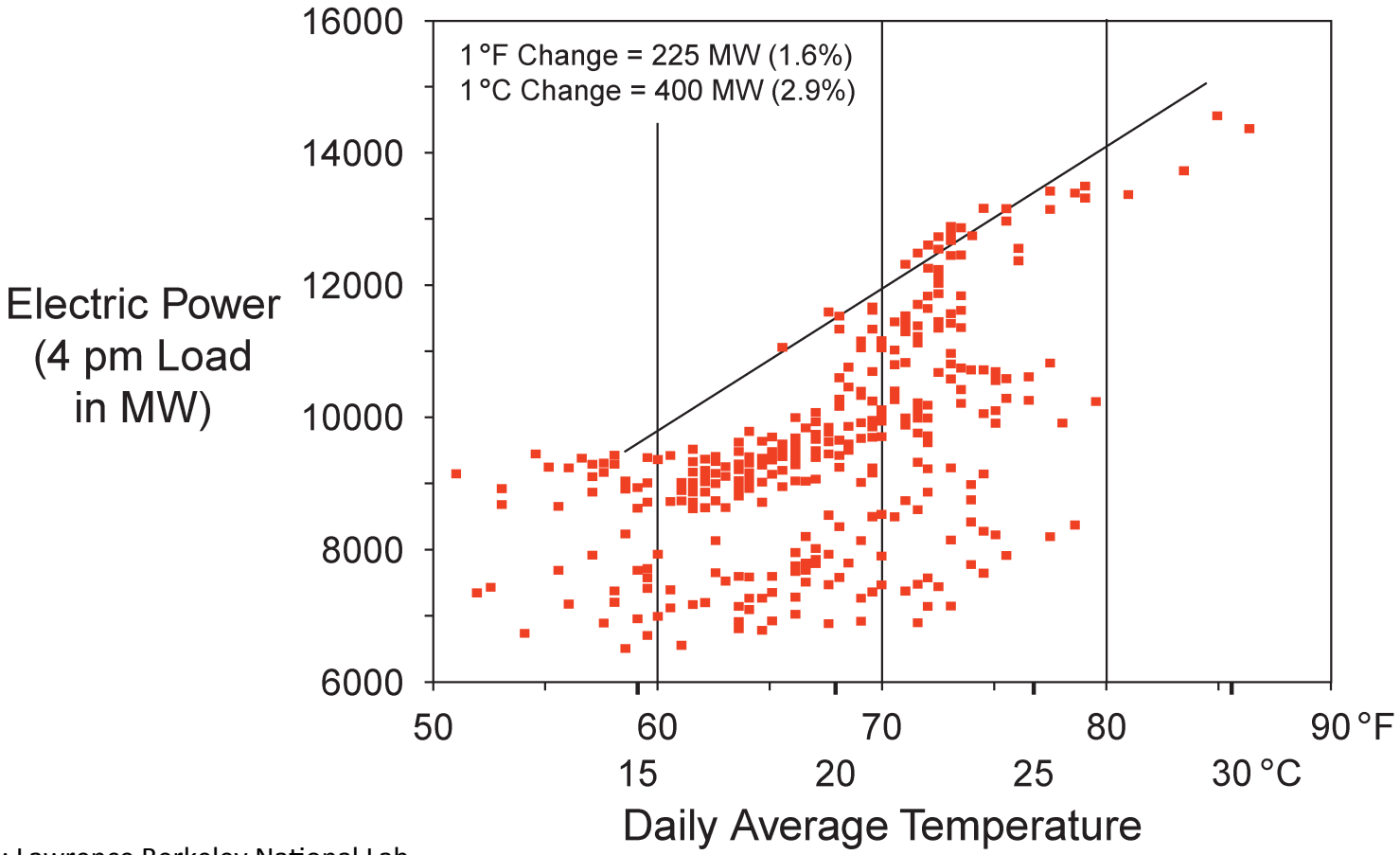
Electricity load and temperature



5-10% of peak electric demand for AC use is due to the urban heat island effect

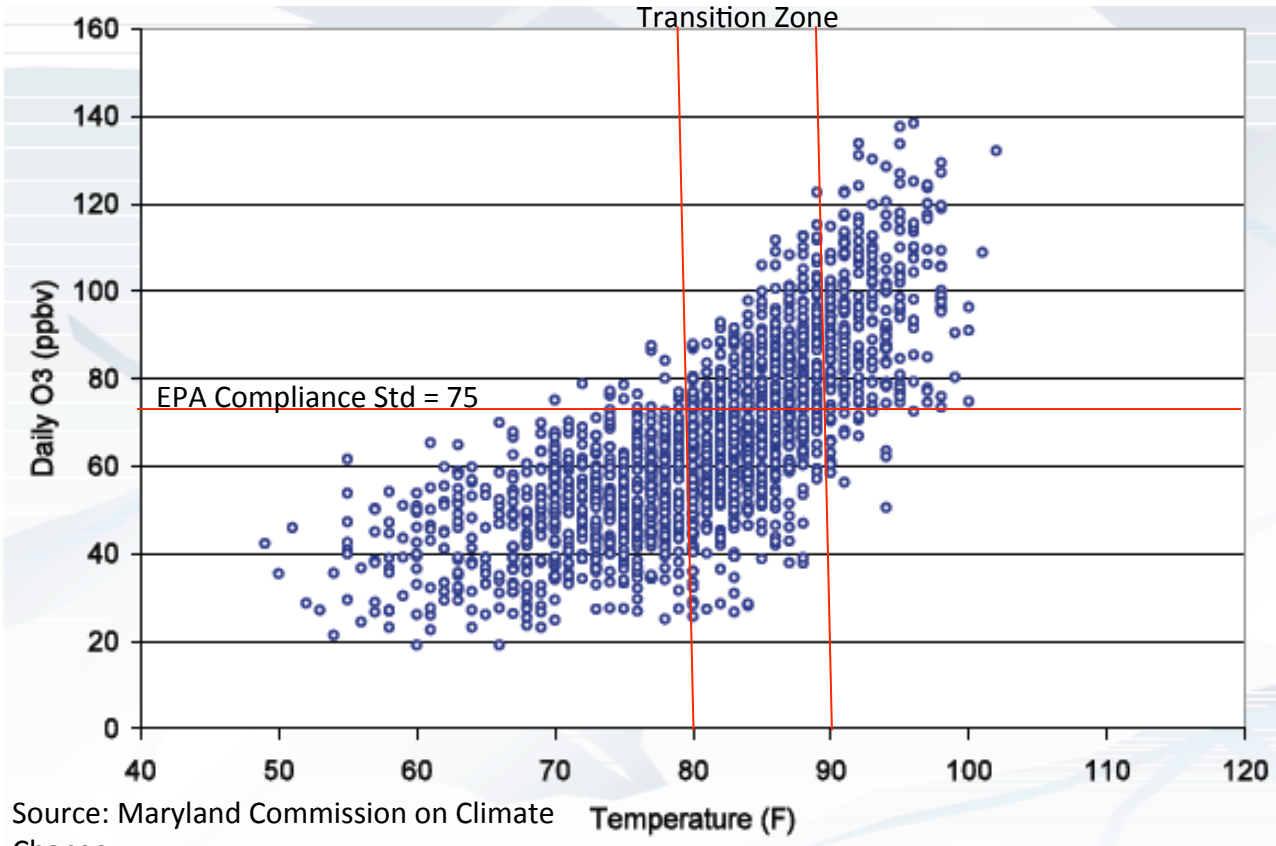
Adapted from Sailor, D. J. 2002. Urban Heat Islands, Opportunities and Challenges for Mitigation and Adaptation. Sample Electric Load Data for New Orleans, LA (NOPSI, 1995). North American Urban Heat Island Summit. Toronto, Canada. 1–4 May 2002. Data courtesy Entergy Corporation.

Electricity load and temperature - LA



Source: Lawrence Berkeley National Lab

Smog formation and temperature

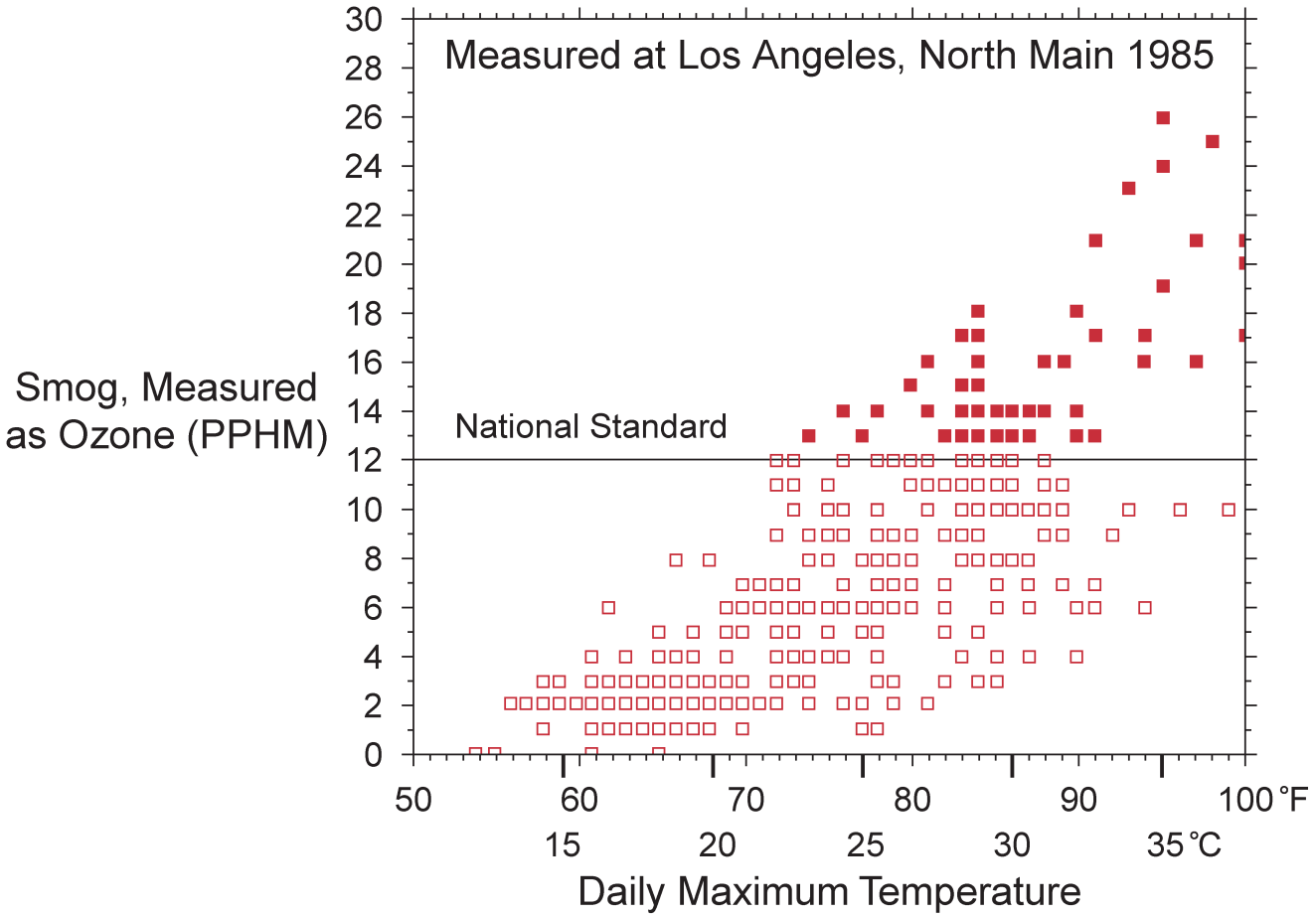


Source: Maryland Commission on Climate Change

Maximum surface temperature at BWI versus peak 8-hr ozone concentrations in the Baltimore non-attainment area for the period May-September, 1994-2004 (Piety, 2007).

Up to 20% of U.S. smog concentrations are due to urban heat islands

Smog formation and temperature - LA

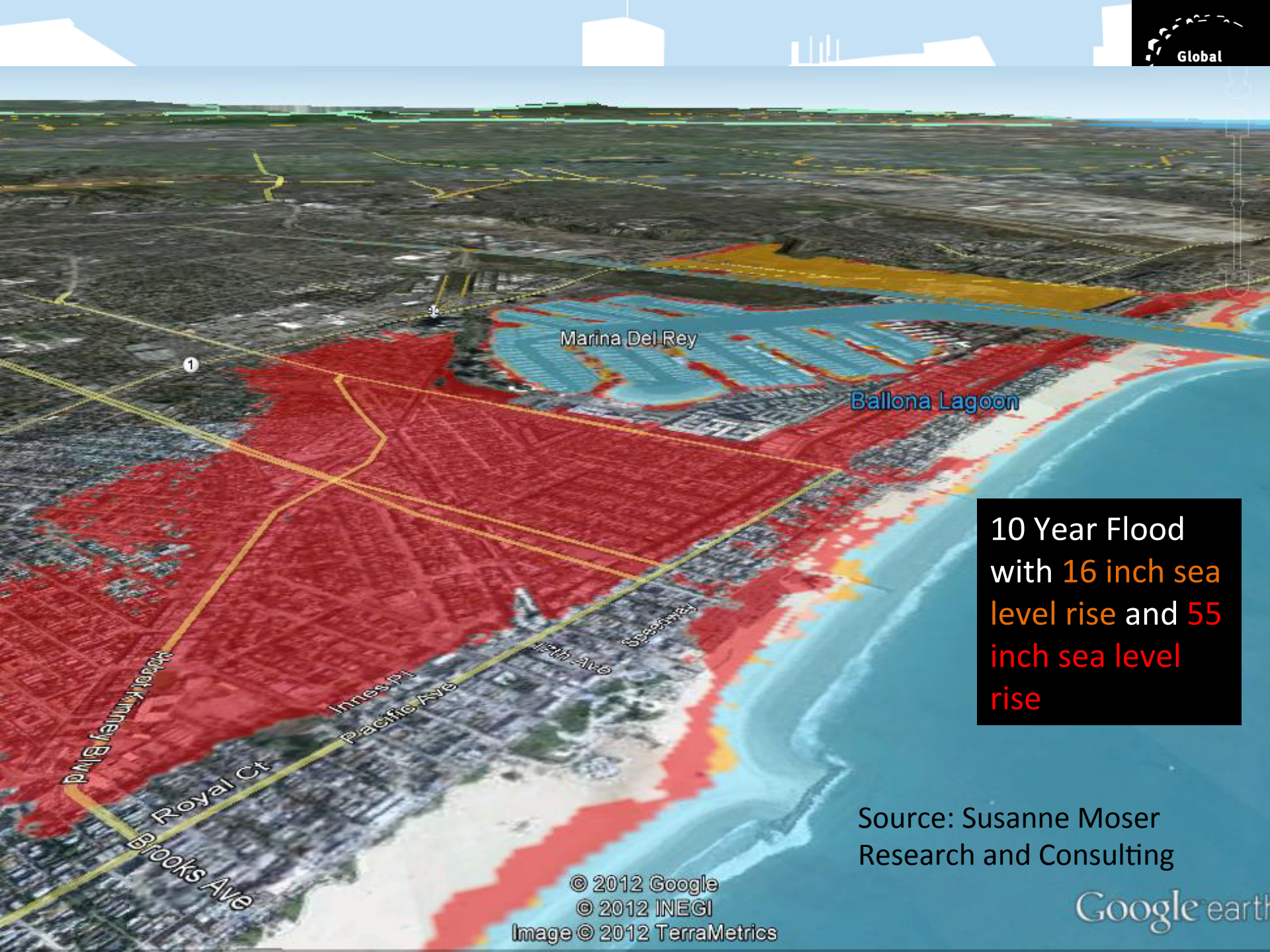


Source: Lawrence Berkeley National Laboratory Heat Island Group

Temperature threats to Los Angeles

- Smog: For every 1°C over 22°C (72°F), incident of smog in LA increases by 5%.
- Risk to drinking water supplies due to snowpack uncertainty.
- Power outages during extreme heat events.
- 2006 CA heat wave – 16,000 extra visits to ER, 140 excess deaths*
- Sea-level rise puts $3.8 billion in property and 3.5 GW of generating capacity at risk in LA County.

**Coming soon: a study of EHE and mortality for LA*



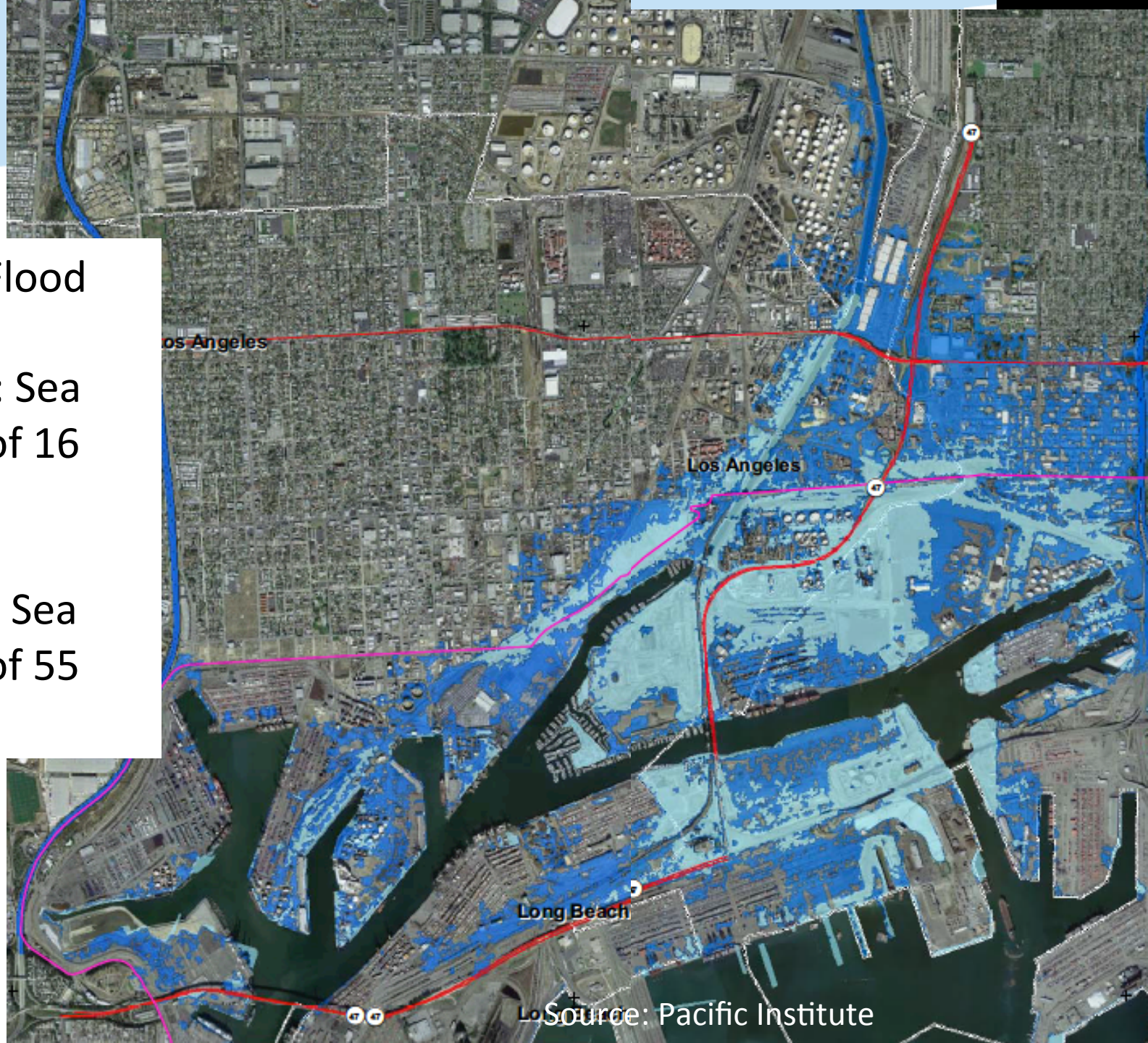
10 Year Flood with 16 inch sea level rise and 55 inch sea level rise

Source: Susanne Moser Research and Consulting

100 Year Flood

Light Blue: Sea level rise of 16 inches

Dark Blue: Sea level rise of 55 inches



Source: Pacific Institute

Global and Urban Heat Trends

The Problem with Excess Urban Heat

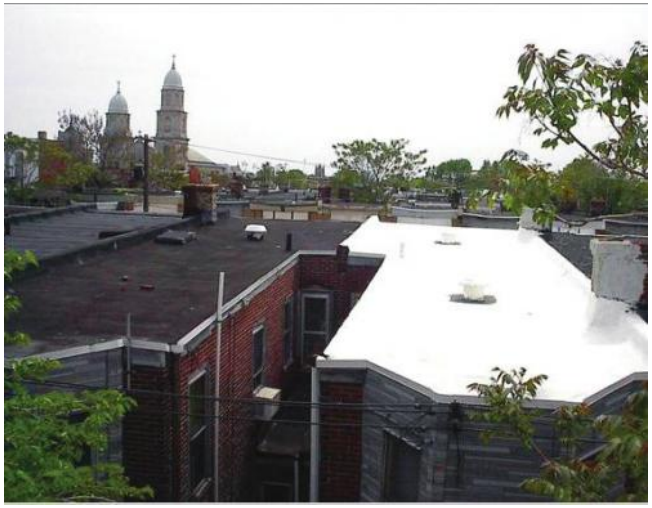
How Cool Surfaces Work

Benefits

Urban Heat Island Mitigation Strategies

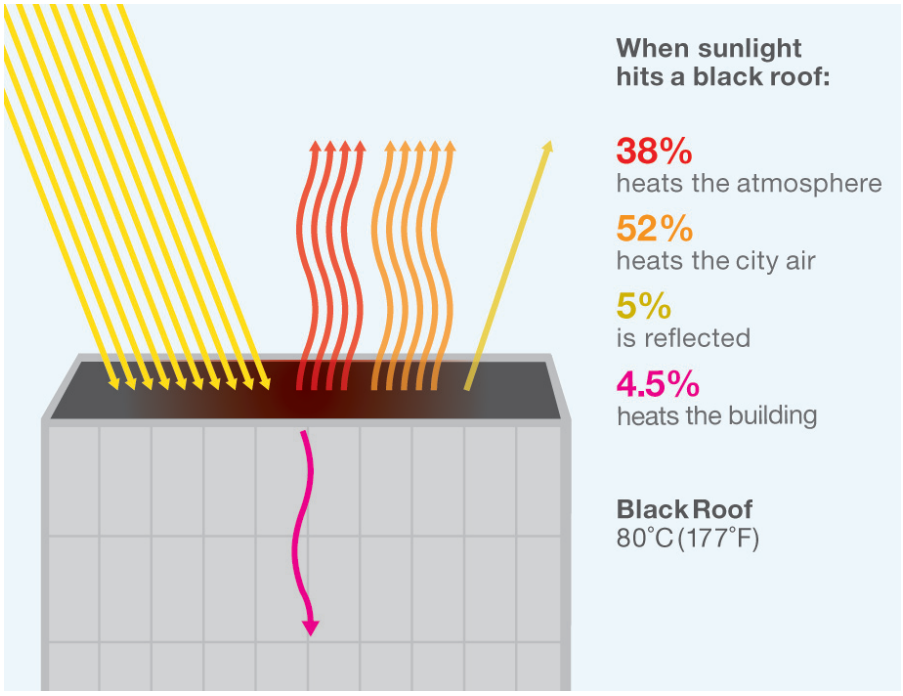
What is a cool surface?

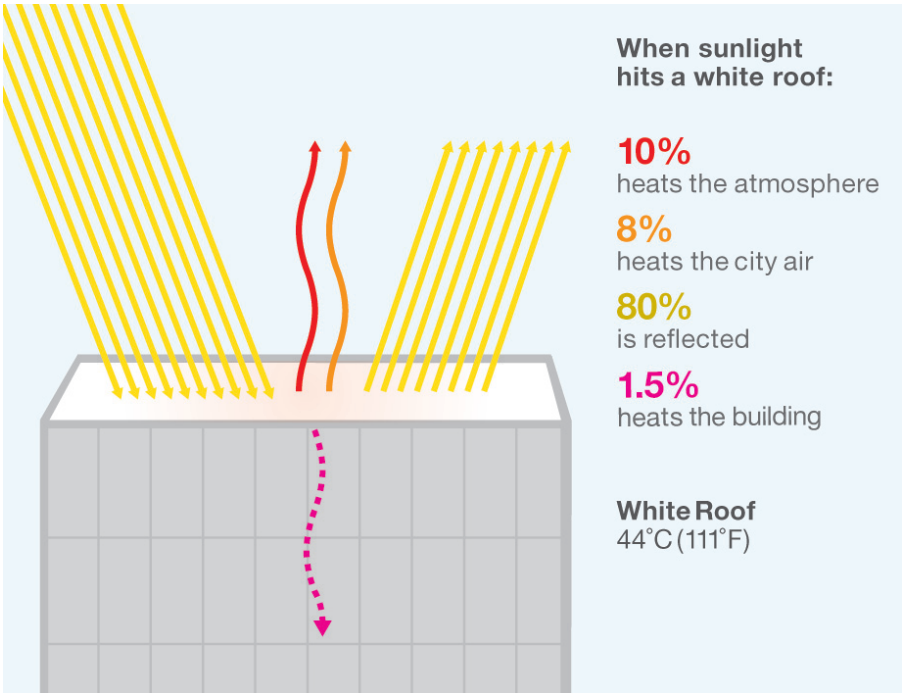
- Surfaces that reflect lots of solar energy and release lots of stored heat energy (i.e., white roofs, light-colored pavements)



- Vegetated surfaces that provide shade or cooling through evapotranspiration (i.e., green roofs, urban canopy, permeable/ pervious pavement)

How cool, reflective roofs work

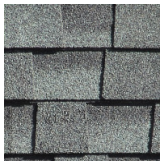




Air Temperature 37°C (99°F)

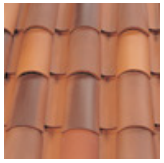
Cool surfaces are measured by how much light they reflect (solar reflectance) and how long they hold heat (thermal emittance).

Almost all roofs have a cool option



Asphalt Shingle (predominant residential roof type in U.S.)

- Lasts 15-30 years
- Cool Options: white or light grey shingles



Clay or Concrete Tiles (clay shown)

- Lasts 30 – 50+ years
- Cool Options: terracotta, cool colored pigment or white

Metal Roofs (often found on commercial, industrial and some low-income residential)

- Lasts 20 – 50+ years
- Cool Options: white/cool coated or painted metal (factory or on-site)

Built-Up Roof (multiple layers covered by ballast or smooth membrane)

- Lasts 10 – 30 years
- Cool Options: white gravel ballast or white smooth membrane

See Page 24 and 25 of the Toolkit for more details and examples

Not just white – there are cool colors too!

Cool color options exist to suit nearly any aesthetic requirement.

Standard Concrete Tiles (SR)	0.04	0.18	0.24	0.33	0.17	0.12
With Cool Coating Applied (SR)	0.41	0.44	0.44	0.48	0.46	0.41

Source: Adapted from data from American Rooftile Coatings.

Comparing Cool Roof Technologies

Source: Adapted from GCCA data. The chart below compares the properties of cool roof technologies. The icons in the chart indicate what characteristics each technology has.

	Cool Roofs	Green Roofs	Solar PV	Insulation
Stormwater management	*			
Clean energy generation				
Energy savings				
Building cooling				
City cooling				
Global cooling				
Low maintenance	**			
Compatible with other environmental roofing strategies				

* Roofs with stormwater management improvements can mitigate 100% of their stormwater runoff.

** White roofs may need periodic cleaning depending on location.

Cool roofs and solar power

- PV panels are 0.5% less efficient for every 1°C above 25°C.
- Reflected light can be captured by some PV and solar hot water units.

Source: J. Emilio Flores for the New York Times

Cool pavements

Pavements are a major part of the urban fabric – nearly 40%.

Global and Urban Heat Trends

The Problem with Excess Urban Heat

How Cool Surfaces Work

Benefits

Urban Heat Island Mitigation Strategies

The Goal: Cleaner and more resilient cities

- Homes, schools, warehouses, and offices that are more comfortable and inexpensive to run.
- Healthier, prosperous, and more productive citizens who enjoy a higher quality of life in urban areas.
- A society that is more resilient to the effects of global climate change.

Cool surfaces are a cost-effective and simple way to achieve these goals by reducing urban temperatures.

The Benefits: Cooler buildings

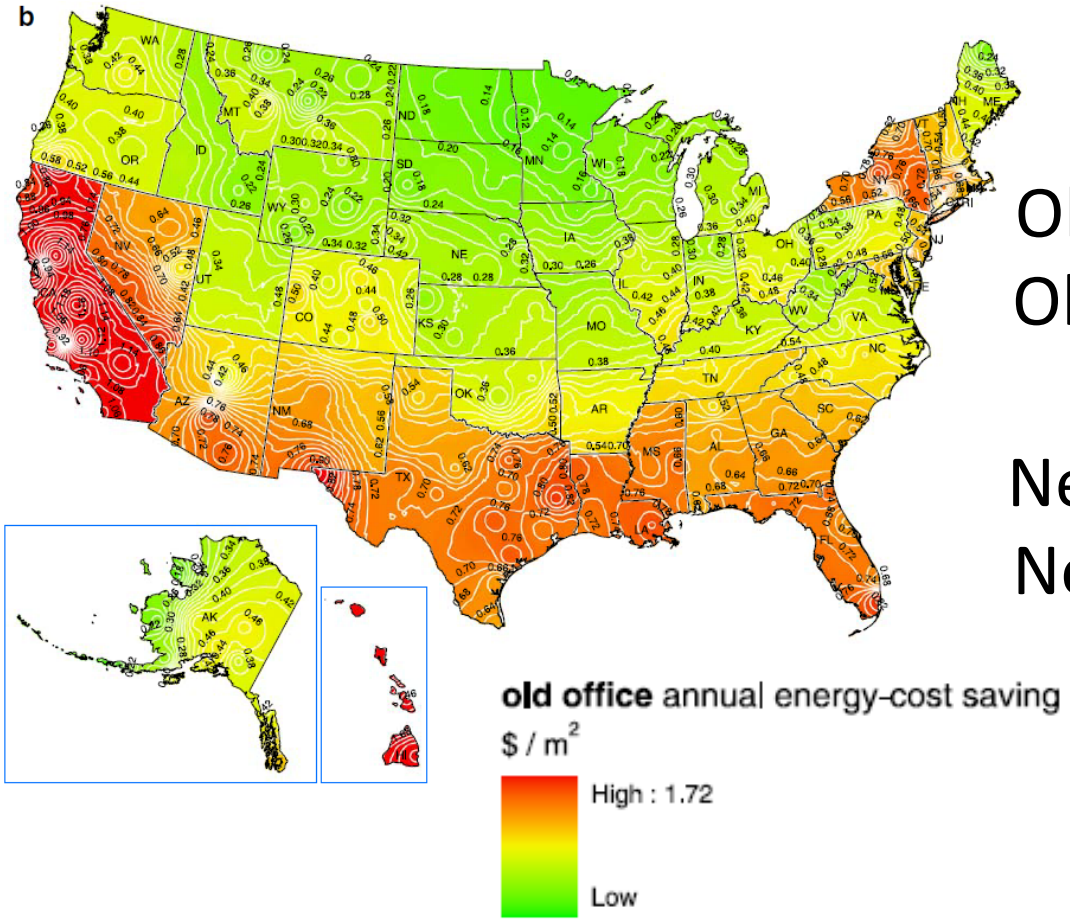
- Cool roofs can cut AC energy use by up to 20 percent on the top floor of conditioned buildings – often avoiding cooling loads at the most expensive times of the day.
  - *$735 million in energy costs savings in the U.S. commercial buildings*

- Cooler surface temperatures may help the roof and the equipment on it last longer.

- Cool roofs improve the comfort and "live-ability" of unconditioned buildings.

UC Davis switched to white membranes ~1980—some still in service 30 yrs later

Net energy cost savings



Los Angeles Area

Old Retail ~$0.13 per sq. ft.
Old Office ~$0.10 per sq. ft.

New Retail ~$0.04 per sq. ft.
New Office ~$0.03 per sq. ft

Source: Levinson & Akbari, 2010

The Benefits: Cooler cities

- Cooling effect will vary by city, but studies indicate a cooling potential of 1 to 3.5°F in LA.

- Peak load reductions, particularly on critical heat days
  - *UHI accounts for 5 – 10% of U.S. peak electricity demand for A/C*
  - *2-4% more AC demand for every 1°C above 20°C*

- Better air quality.
  - *A study of Los Angeles found that cooler surfaces and shade trees could cut unhealthy air by up to 12 percent – a $104M opportunity.*

- Greater resiliency to extreme heat and improved quality of life

A real-world example of regional cooling

The whitewashed greenhouses of Almeria, Spain have cooled the region by 0.8 degrees Celsius each decade compared to surrounding regions, according to 20 years of weather station data.

Source: Google Earth

The Benefits: Global Cooling

- Whitening 1000 sq. ft. of gray roofing cancels the warming effect of 10 tons of CO_2 emissions.
  - Globally, cancels 500 medium sized coal power plants worth of greenhouse gas emissions. (more than CFL deployment)

- Direct mitigation in LA (new – existing buildings):
  - Office ~0.25 – 0.80 lbs. per sq. ft.
  - Retail ~0.30 – 1.0 lbs. per sq. ft.

Benefits to LA*

Installing vegetated/cool roofs on 30% to 50% of existing roof structures would:

- **Cut** annual direct energy use by between 565K MWh and 1.6M MWh (127,000 homes)
- **Save** LA residents $73 to $211M per year
- **Reduce** direct GHG emissions by 162K to 465K tonnes. (91,000 cars off the road)

* Per *Looking Up: How Green Roofs and Cool Roofs Can Reduce Energy Use, Address Climate Change, and Protect Water Resources in Southern California.* NRDC and UCLA School of Law Emmett Center on Climate Change and Environment

Cool roof costs are comparable to dark roofs

Roof Materials	Typical Non-Cool Surface	Cool Alternative	Price Premium (US$ per ft^2)
Built-Up Roof	Mineral aggregate embedded in flood coat	Light-colored aggregate, like marble chips, gray slag	0.00
	Asphaltic emulsion	Field-applied coating on top of emulsion	0.80–1.50
	Mineral surfaced cap sheet	White mineral granules	0.50
Metal	Unpainted metal	May already be cool	0.00
		Factory-applied white paint	0.20
	Painted metal	Cool-colored paint	0.00–1.00+
Modified Bitumen	Mineral surface cap sheet	Factory-applied coating, white mineral granules	0.50
	Gravel surface in bitumen	Light colored gravel	0.00
	Metallic foil	May already be cool	0.00
		Field-applied coating	0.80–1.50
	Asphalt coating	Field-applied coating on top of asphaltic coating	0.80–1.50
Shingles	Mineral granules	White granules	0.00
		Cool-colored granules	0.35–0.75
Sprayed Polyurethane Foam	Liquid applied coating	Most coatings are already cool to protect the foam	0.00
	Aggregate	Light colored aggregate	0.00
Thermoplastic Membranes	White, colored, or dark surface	Choose a white or light colored surface	0.00
ThermoSet Membranes	Dark membrane, not ballasted (adhered or mechanically attached)	Cool EPDM formulation	0.10–0.15
		Factory cool ply or coating on dark EPDM	0.50
Tiles	Non-reflective colors	Clay, slate (naturally cool)	0.00
		Cool colored coatings	0.00

Global and Urban Heat Trends

The Problem with Excess Urban Heat

How Cool Surfaces Work

Benefits

Urban Heat Island Mitigation Strategies

Samples of city cool roof policies

City-wide codes and ordinances

- New York City, Philadelphia, Washington DC, Chicago, Houston

Incentives

- Toronto rebate program
- Portland permitting incentives
- Philadelphia coolest block contest

Volunteer programs

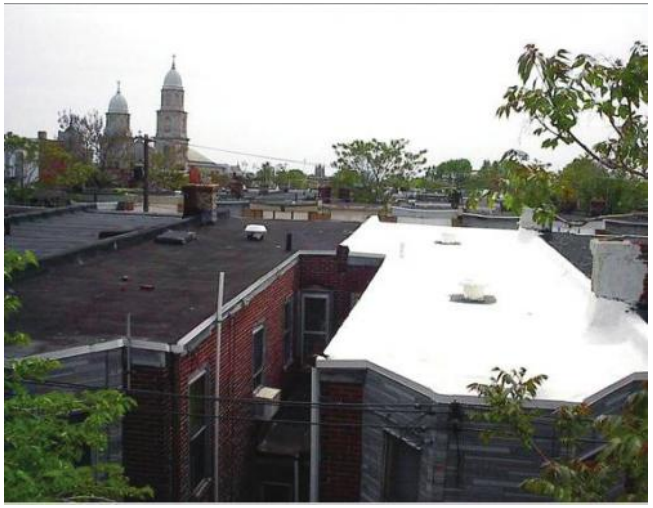
- New York City

Climate adaptation / UHI strategies

- Houston, Dallas, Melbourne, London

Government building specifications

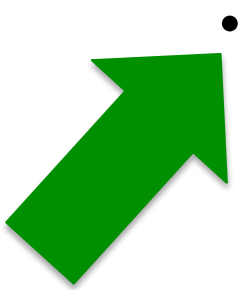
- Washington DC



Best practices

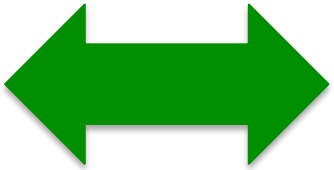
Planning:

- Set measureable goals
- Consider cross-cutting impact
- Life-cycle costs and benefits
- Broad stakeholder participation



Evaluation:

- Combination of actual and modeled results.
- Infrastructure for ongoing monitoring
- Feedback for implementation



Implementation:

- Focus on training and capacity building
- Engage private sector
- Data-driven performance

A few ideas for LA

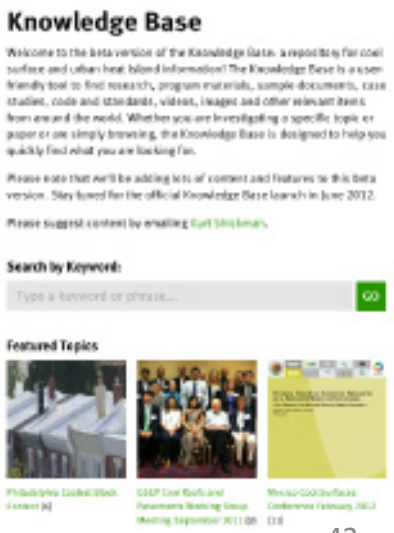
- Continue already strong strategic focus on UHI: AdaptLA, GreenLA, Million Trees LA. Encourage lots of little actions!
- Incentives for private use (financial, permitting etc.)
- Raise awareness of cool roof and solar connection (esp. with feed-in tariffs)
- Enhance existing CA Title building codes – expand into residential, stretch performance targets, enhanced code enforcement
- Pilot cool pavements on roads, parking lots, and playgrounds
- LADWP – Targets at least a 10% reduction in consumption with a soft target of 15% by 2020. Doubled EE budget in May 2012.

Resources for Los Angeles

- Global Cool Cities Alliance (GlobalCoolCities.org) and the Cool Roof Toolkit (CoolRoofToolkit.org)
- Climate Resolve (ClimateResolve.org)
- C40 (*C40cities.org*)
- NRDC (NRDC.org), UCLA Emmett Center
- LBNL Heat Island Group (HeatIsland.LBL.gov)

The Cool Roofs and Pavements Toolkit
www.CoolRoofToolKit.org

- Descriptions of the science, the benefits, and the costs of cool surfaces.
- Simple steps to implement programs and policies drawn from global best practices.
- Links to sample materials and relevant organizations.
- A comprehensive “knowledge base” of research, best practices, code/ordinance language, sample program materials.
- Coming soon: a global expert forum



Thank You!

Kurt Shickman
Executive Director
Global Cool Cities Alliance
kurt@globalcoolcities.org
GlobalCoolCities.org / CoolRoofToolKit.org
202-550-5852