Cool Fixes for Hot Cities
Part 2: Los Angeles

September 12, 2018

Hosted by:

U.S. EPA Heat Island Reduction Program

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HEAT ISLAND REDUCTION PROGRAM

State and Local Energy and Environment Program

Pavement Choices for Cooler Cities

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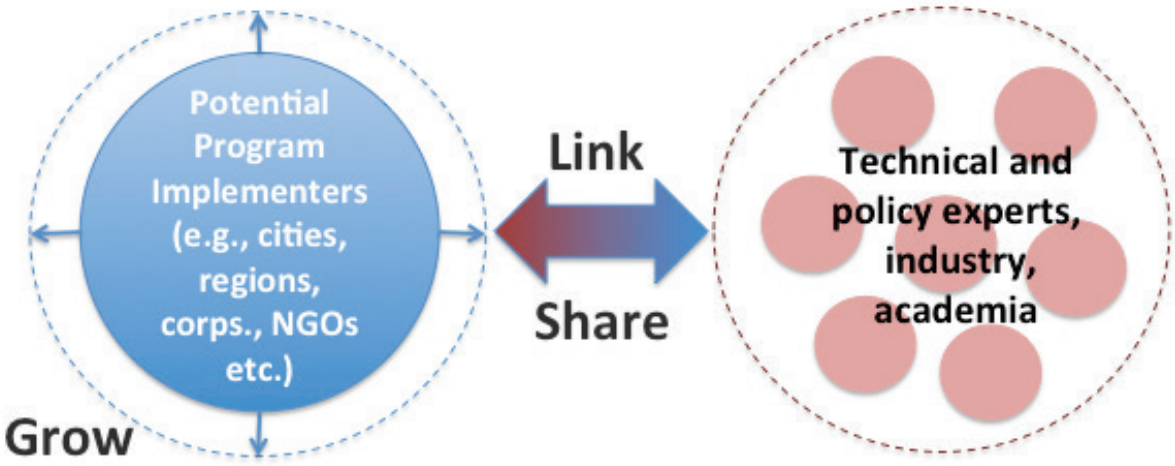
Global Cool Cities ALLIANCE

1. Overview
2. Performance and Impact
3. Considerations
4. Product Round-up

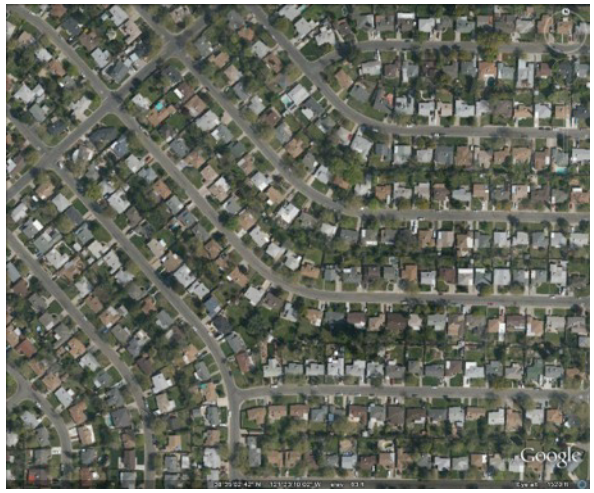
Global Cool Cities Alliance (GCCA)

The Global Cool Cities Alliance is dedicated to advancing policies and actions that reduce excess urban heat in order to cool buildings, cool cities, and to mitigate the effects of climate change through global cooling.



CoolRoofToolkit.org

Pavement makes up 1/3rd of the average city



Of that third, about

- 45% are streets (usually asphalt concrete)
- 15% are sidewalks (usually cement concrete)
- 40% is exposed parking (usually asphalt concrete)

Two options for cooler pavements

High solar reflectivity

Cools by reflecting, rather than absorbing, solar energy

Permeable/porous

Cools via evapotranspiration

Reflectivity of common urban surfaces

(also known as albedo)

Common Albedo Values (Emerald Cities)			
Fresh Asphalt	0.05	Fresh Grey Portland Cement	0.35
Black Soil	0.13	Desert Sand	0.40
Bare Soil (land)	0.17	Cool Pavement Coatings	+0.50
Aged Asphalt	0.20	Arctic Region	0.77
Green Grass	0.25	White Portland Cement	0.80
Aged Portland Cement	0.29	White Roof Coatings	0.88

Higher solar reflectance (SR) = lower surface temperatures

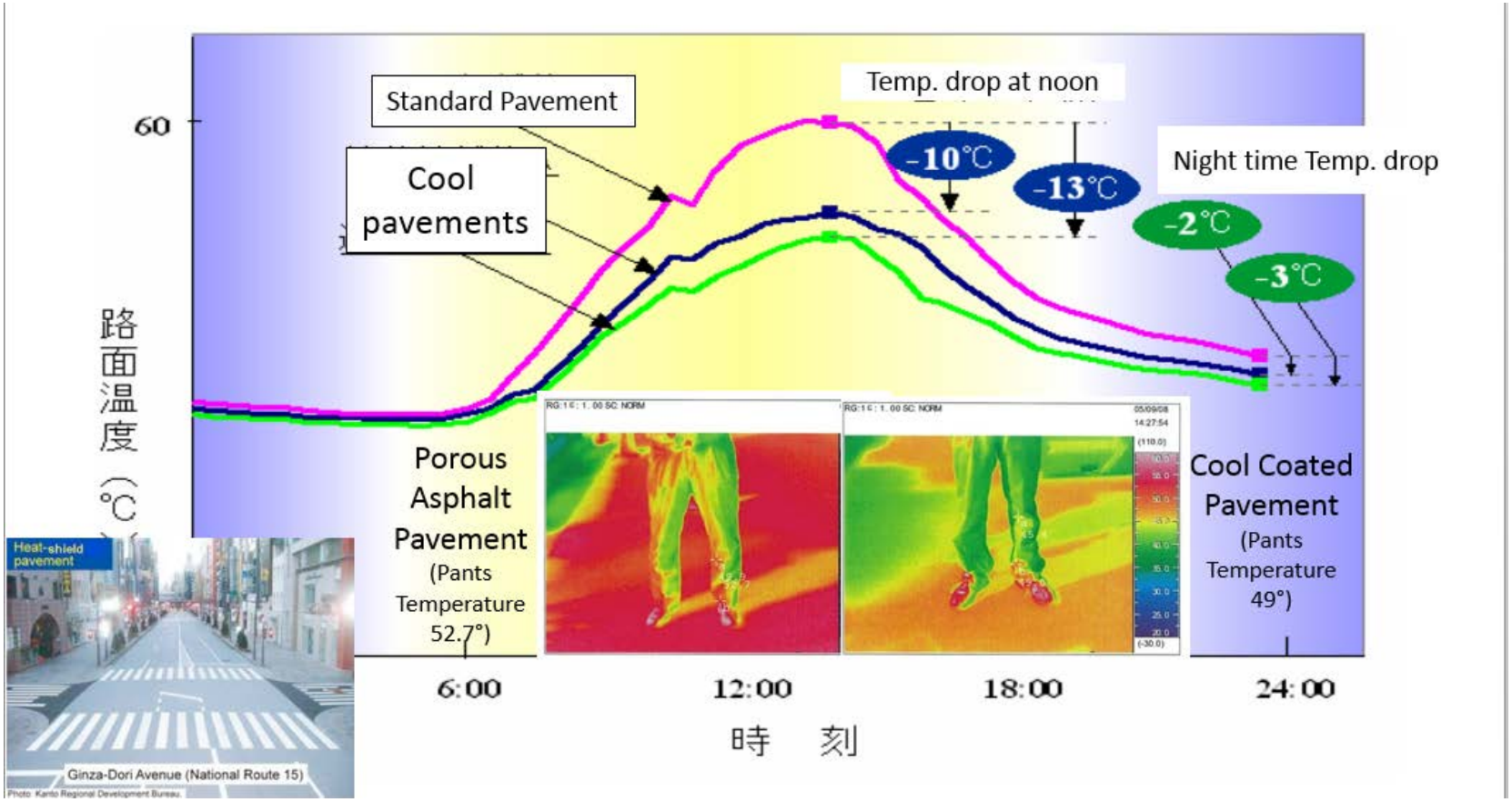
SR 0.06 → SR 0.32 → SR 0.46

58.8°C (138°F) → 46.2°C (115°F) → 41.4°C (107°F)

- Measurements performed in Berkeley, 26 June 2012
- Air temperature 22.5°C (72.5°F), no wind or clouds

Increasing pavement SR by 0.1 decreases temperature ≈ 7°F (4°C)

Cool pavements pilot results (Tokyo)



Longer pavement life

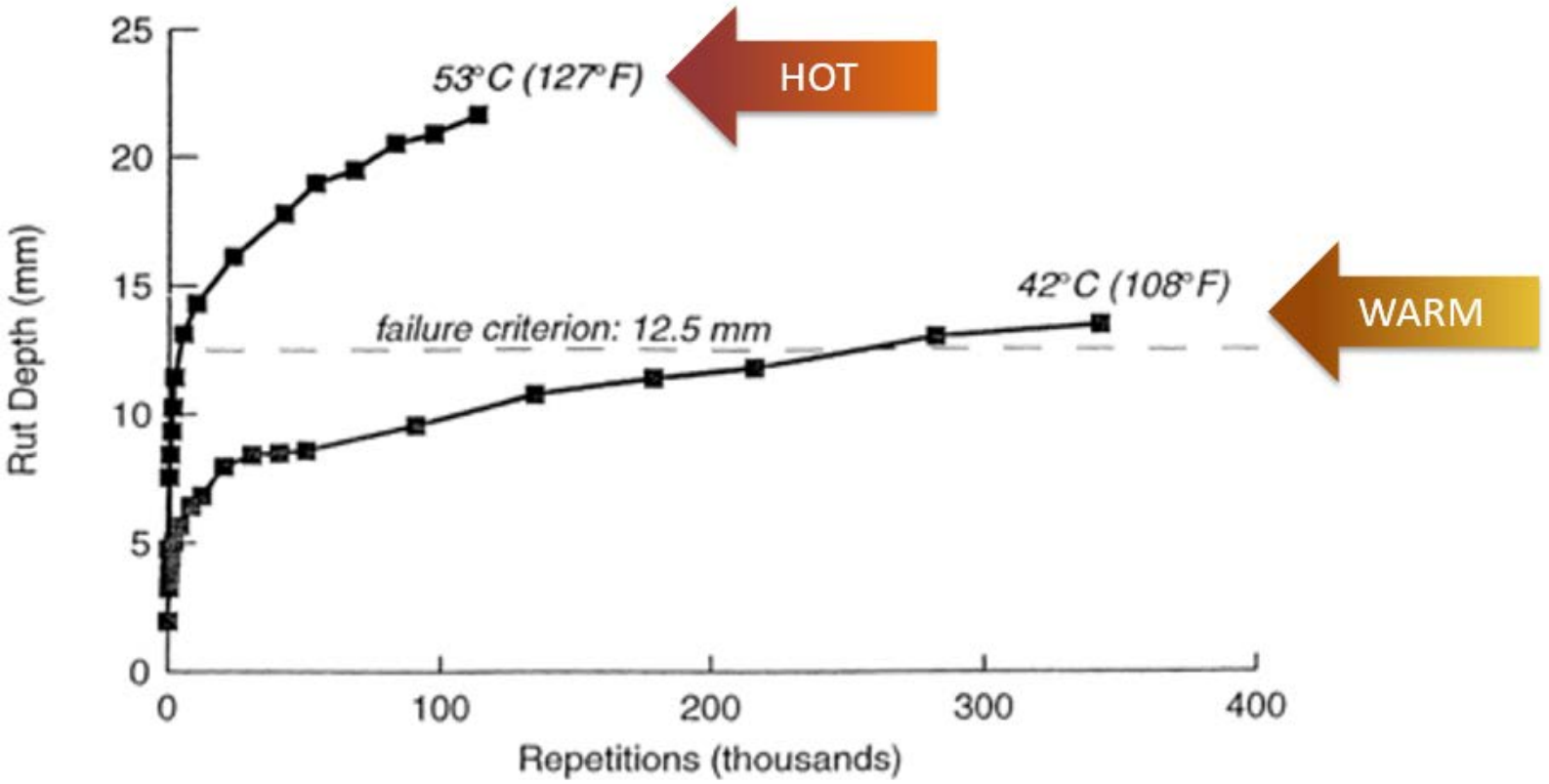


Fig. 2. Depth of Rutting vs Number of Repetitions of a Standard Axle Load, Wide-base Single Tire, at Pavement Surface Temperatures of 42°C and 53°C

Source: Pomerantz, Akbari, Harvey (2000)

Enhanced visibility and safety

- Nighttime illumination

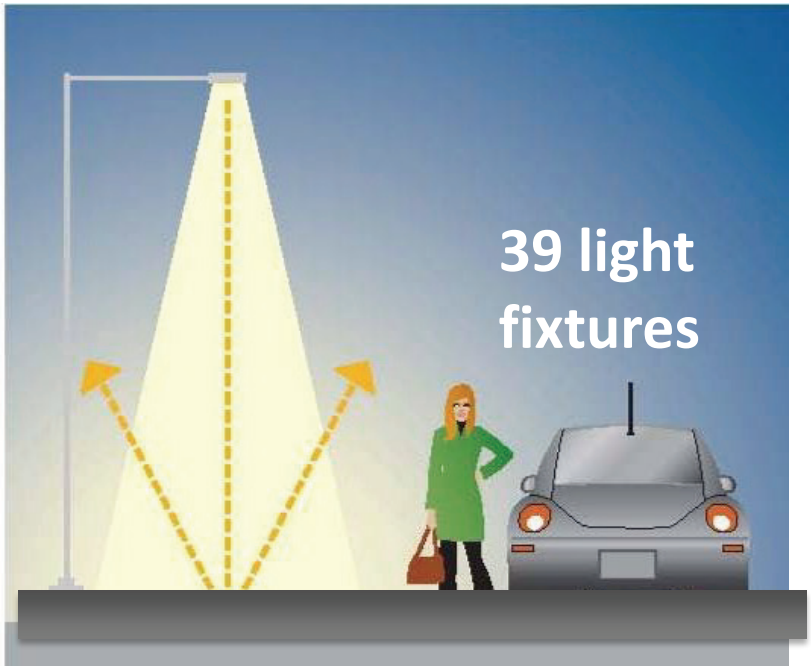
- Reflected illumination is roughly proportional to solar reflectance

Source: Pomerantz et al (2003)

Energy savings

- Reduced energy for street lighting
  - Enhanced illumination or fewer fixtures

Source: Stark, R.A. (1986)



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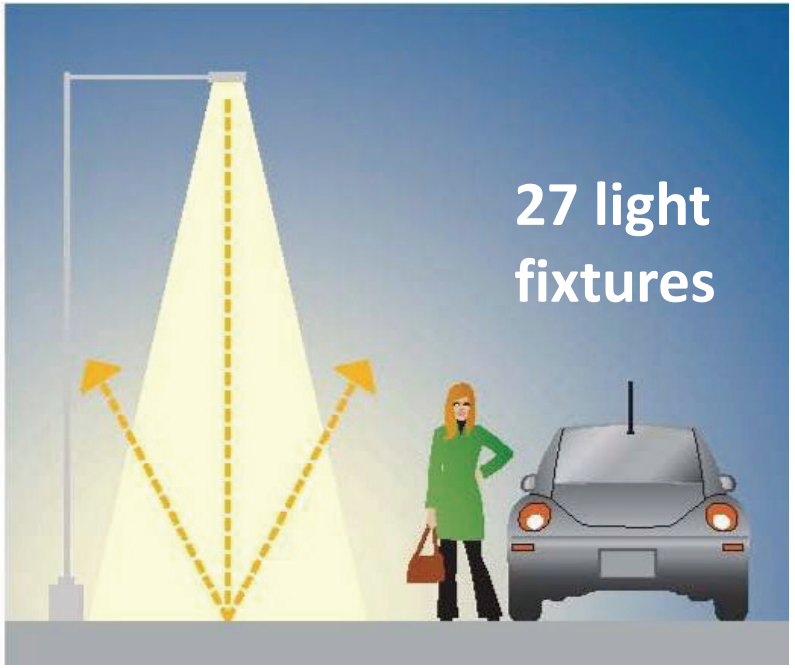


Dark pavement **Light pavement**

May also enhance building daylighting. Impact on air conditioning use is building specific.

Preserved water quality

- EPA's Clean Water Act addresses heat pollution – temperature is "pollutant of concern"
- Ultra urban streams warm by 8°F one hour after summer squalls
- A change of 5°F over 5 hours can induce stress in most desirable species of fish

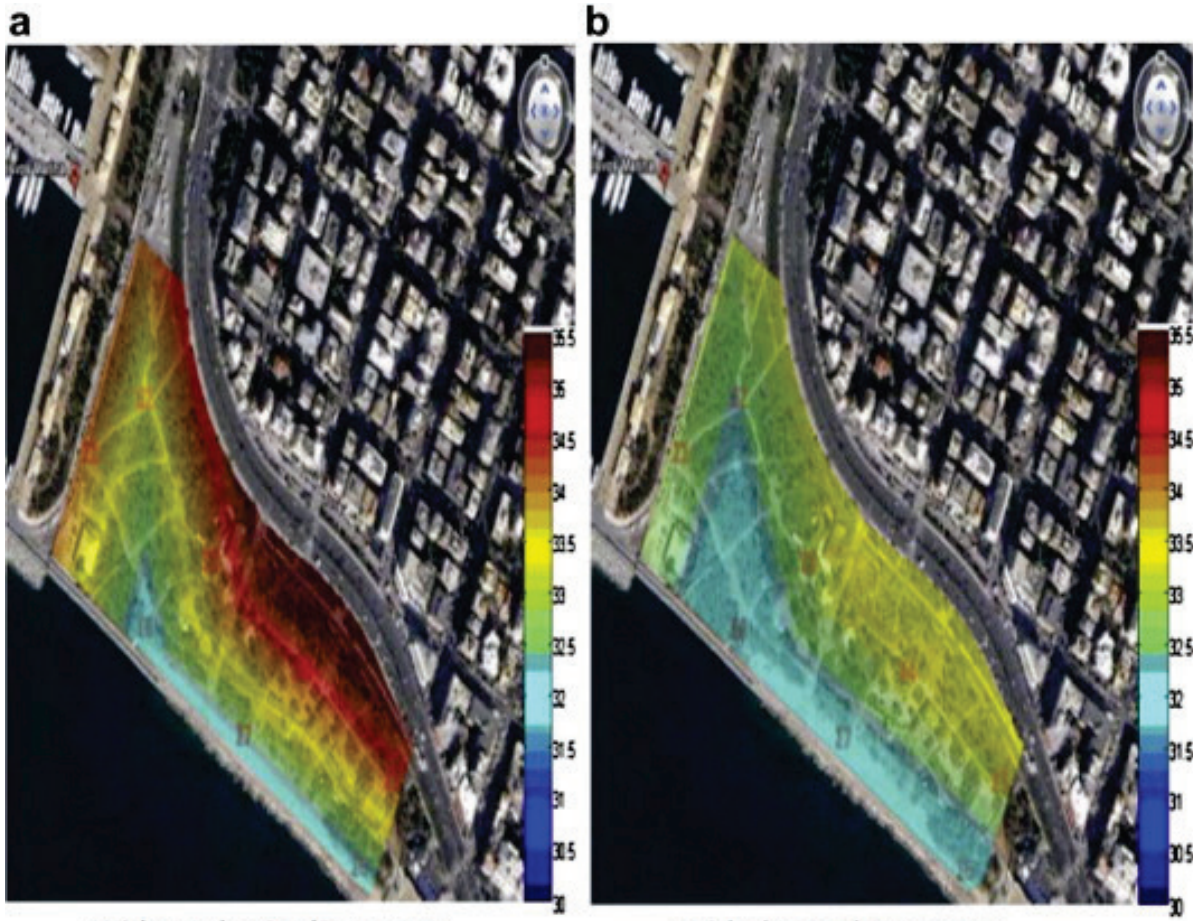
Brook Trout

Photo: Eric Engbretson

Source: US EPA

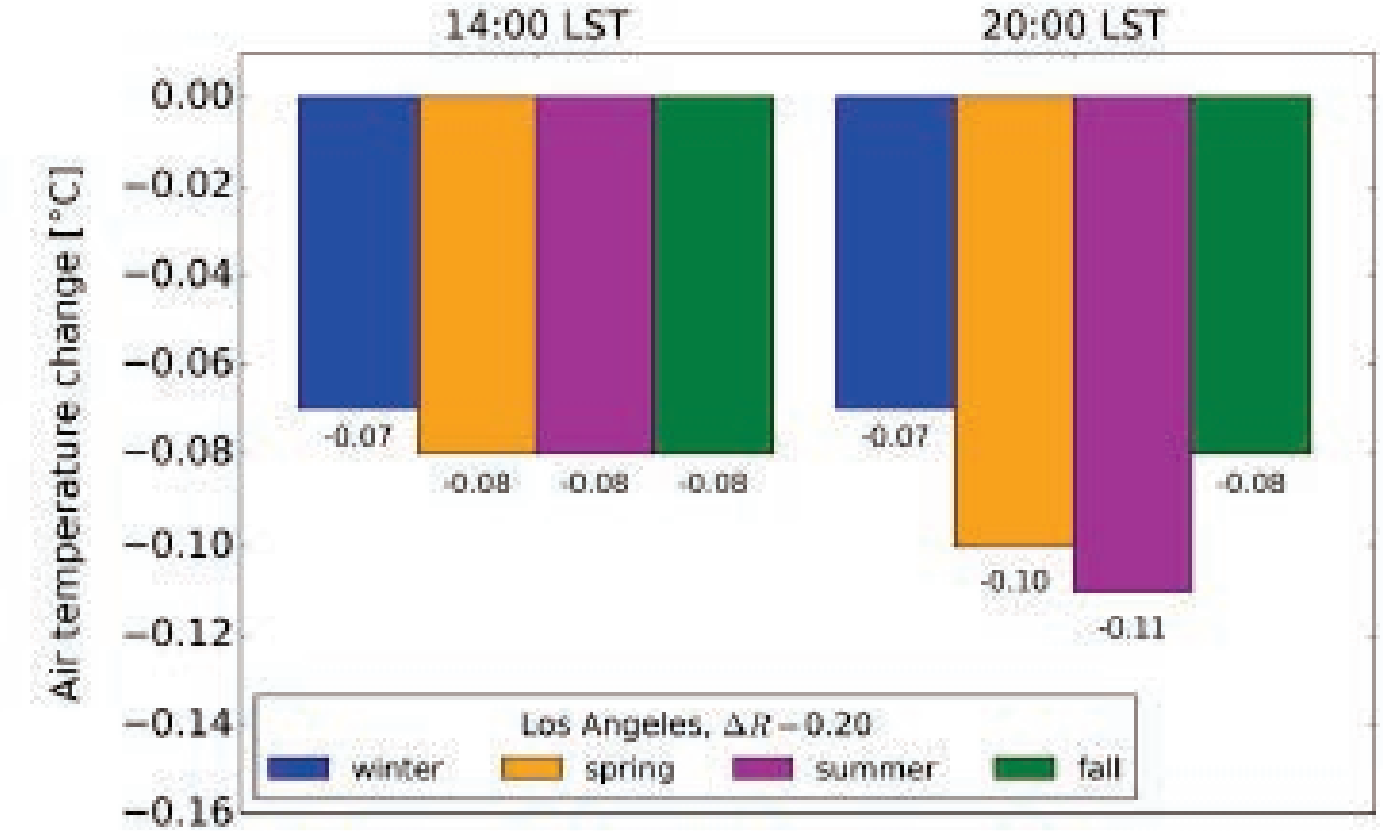
Improved outdoor comfort

- An urban park in Athens, Greece installed 4,500 m^2 of cool pavements
- Reduced peak air temperatures by 2°C (Santamouris et al. 2012)



Flisvos Park in Athens, Greece (Santamouris et al. 2012)

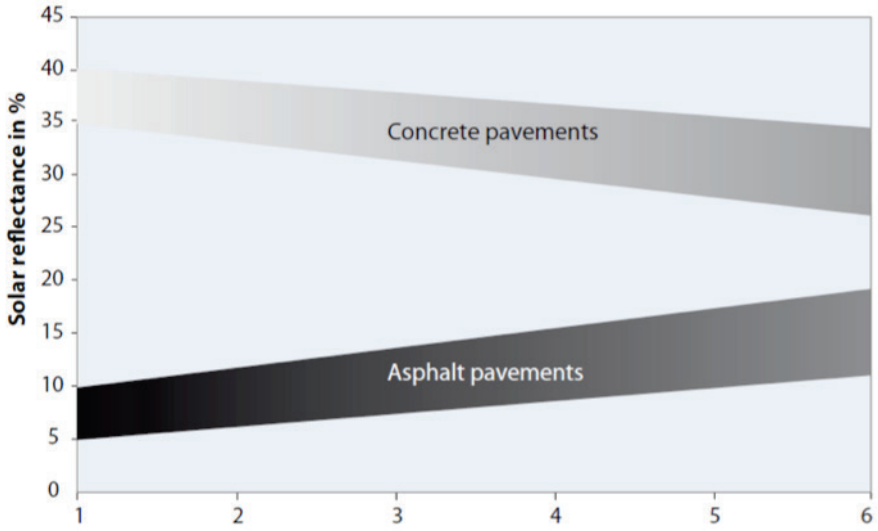
Air temperature reductions – city scale



Source: LBNL, UC Davis & USC. *Life-Cycle Assessment and Co-Benefits of Cool Pavements*

Simulated cooling rate of 0.9°C per 0.1 SR increase is in line with other major findings

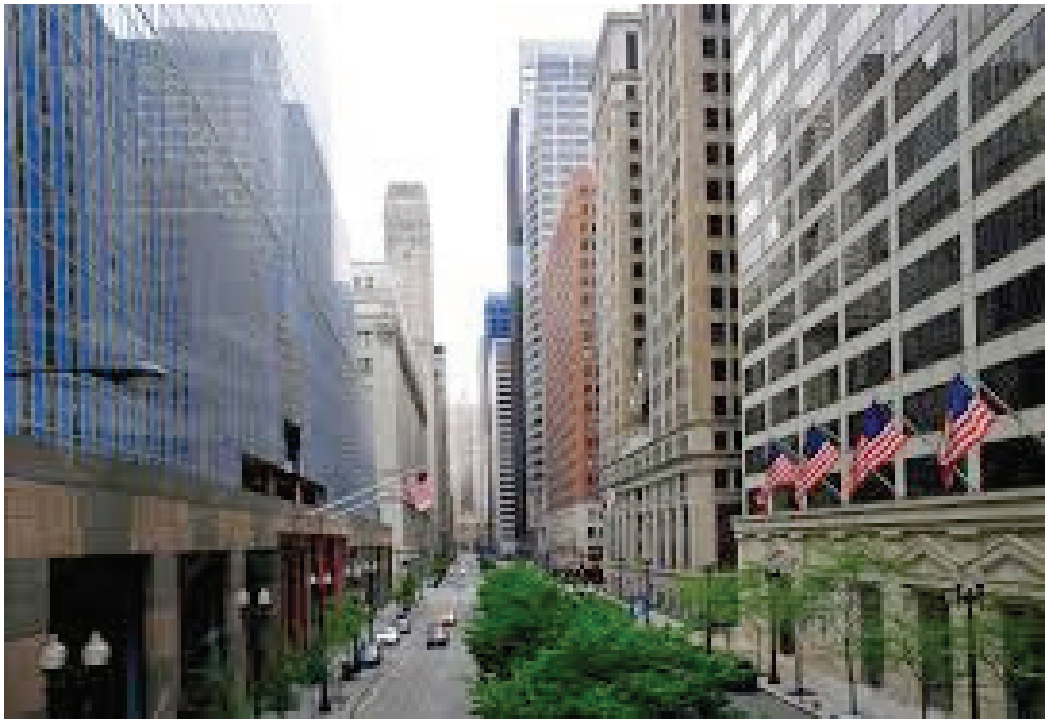
Issues to consider (relatively minor)



Reflectivity changes over time

Shading from trees, buildings, cars etc. may lessen urban heat island reduction potential of pavements

Issues to consider (uncertain)



Pavement/Building Interactions are a Complex System

- Building orientation, vintage, window:wall ratio, proximity to pavement
- Possible increase in reflectivity-related cooling demand
- Possible reduction in cooling demand due to cooler air
- Possible reduction in internal lighting loads

Issues to consider (potentially major)

- First cost (1.5 – 2.5x premium in some cases)
- Impact on recyclability of asphalt pavement
- Potentially negative impact on pedestrian comfort due to radiated solar energy, if not paired with shade solutions.
- Lifecycle global warming potential (GWP) may outweigh urban heat island benefit.

Cool Pavement Options

Lighter aggregate (asphalt)

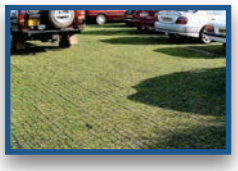
Coatings, slurries, overlays (asphalt)

Fine light aggregate (cement)

Slag addition (cement)

Permeable/Pervious

Clear resin (w/light aggregate)



Grass pavers

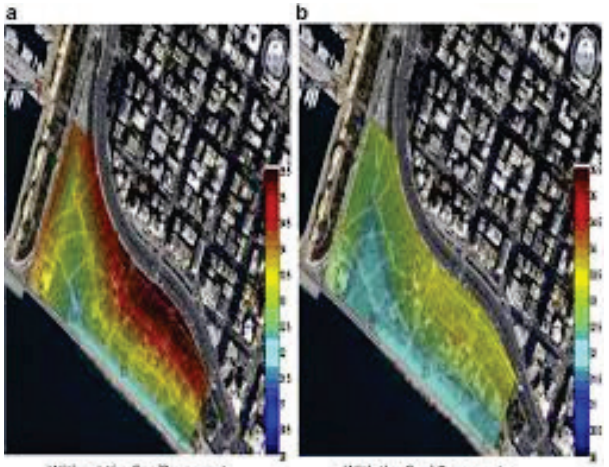
Titanium dioxide (TiO_2) addition

What's Next for Cool Pavements?

More pilots (e.g., Los Angeles, Melbourne, Athens, Tokyo, Chula Vista)

More locally relevant studies/discussions (e.g., AB296, New York City)

More innovation (price point, GWP, broader product offerings)



Thank you!

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Overview of Cool Pavements for Heat Island Reduction - Supplemental Slides

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Cool Coatings Products

Plexipave Acrylotex – acrylic coating
California (CA) cost ($/m^2): $7.50 - $12 (installed)
SR: 0.2 - 0.4

GAF Streetbond Durashield – acrylic coating
CA cost ($/m^2) - $1.70 (material)
SR: 0.36

GAF Streetbond 120 & 150 – epoxy-modified acrylic coating
CA cost ($/m^2) - $6 - $9 (materials)
SR: 0.30 – 0.60

Seal Coat Products

Western Colloid Armor Top – asphaltic coating
CA cost ($/m^2): $1.50 - $2 (material)
SR: 0.19 - 0.25

Guard Top Cool Seal – water-based asphaltic coating
CA cost ($/m^2) - $1.90 - $2.60 (material)
SR: 0.27 – 0.33

Overlay Products

Polycon E-Krete – Polymer Composite Micro Overlay
CA cost ($/m^2): $4.00 - $4.80 (material)
SR: 0.36 - 0.42

E-Pave I and II – cold applied Polymer Enhanced Composite
CA cost ($/m^2) - unknown
SR: unknown

Acrypave Tuff Seal – Portland-based Polymer Micro Overlay
CA cost ($/m^2) - $5.40 - $10.80 (material)
SR: 0.34

Resin Products

Soil Stabilization Services NaturalPave – resin asphalt additive
CA cost ($/$m^2$): $21.50 - $54.00 (material)
SR: Up to 0.45 (depending on aggregate color

Connect with the Heat Island Program

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