



# Cool Roofs and Urban Heat Islands

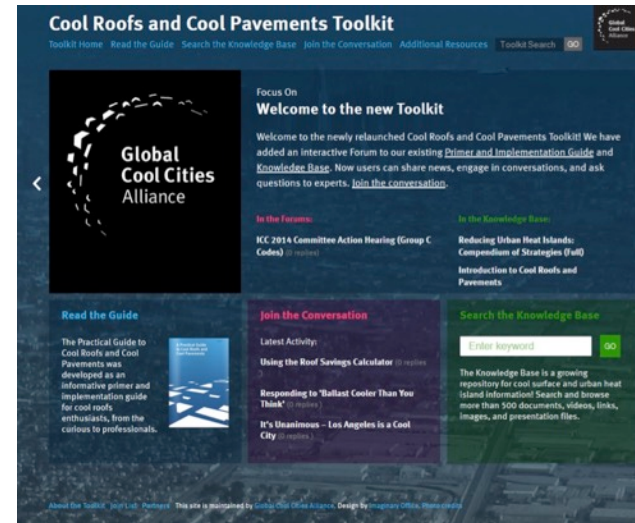
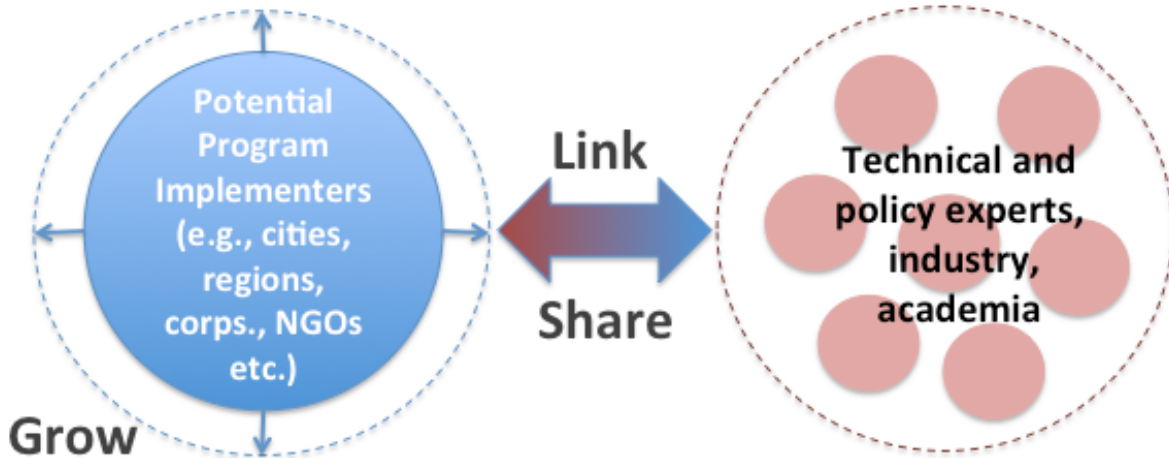
USGBC Member Meeting

Kurt Shickman  
June 15, 2015



# 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.

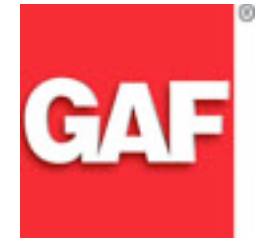
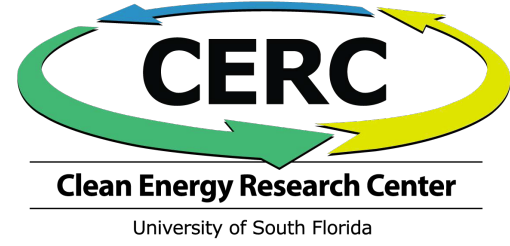




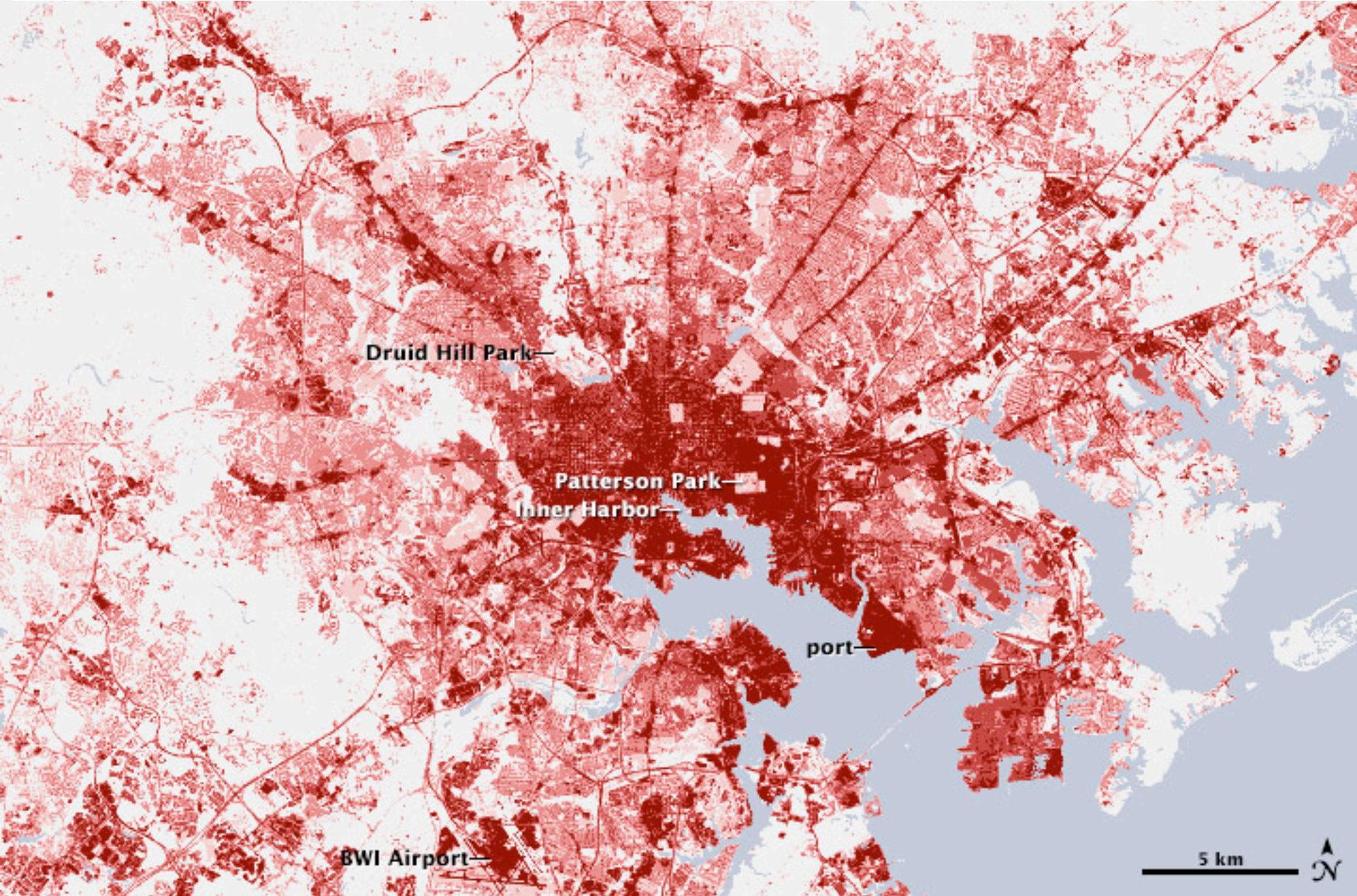
U.S. DEPARTMENT OF **ENERGY** | Energy Efficiency & Renewable Energy



ENERGY FOUNDATION  
building a new energy future

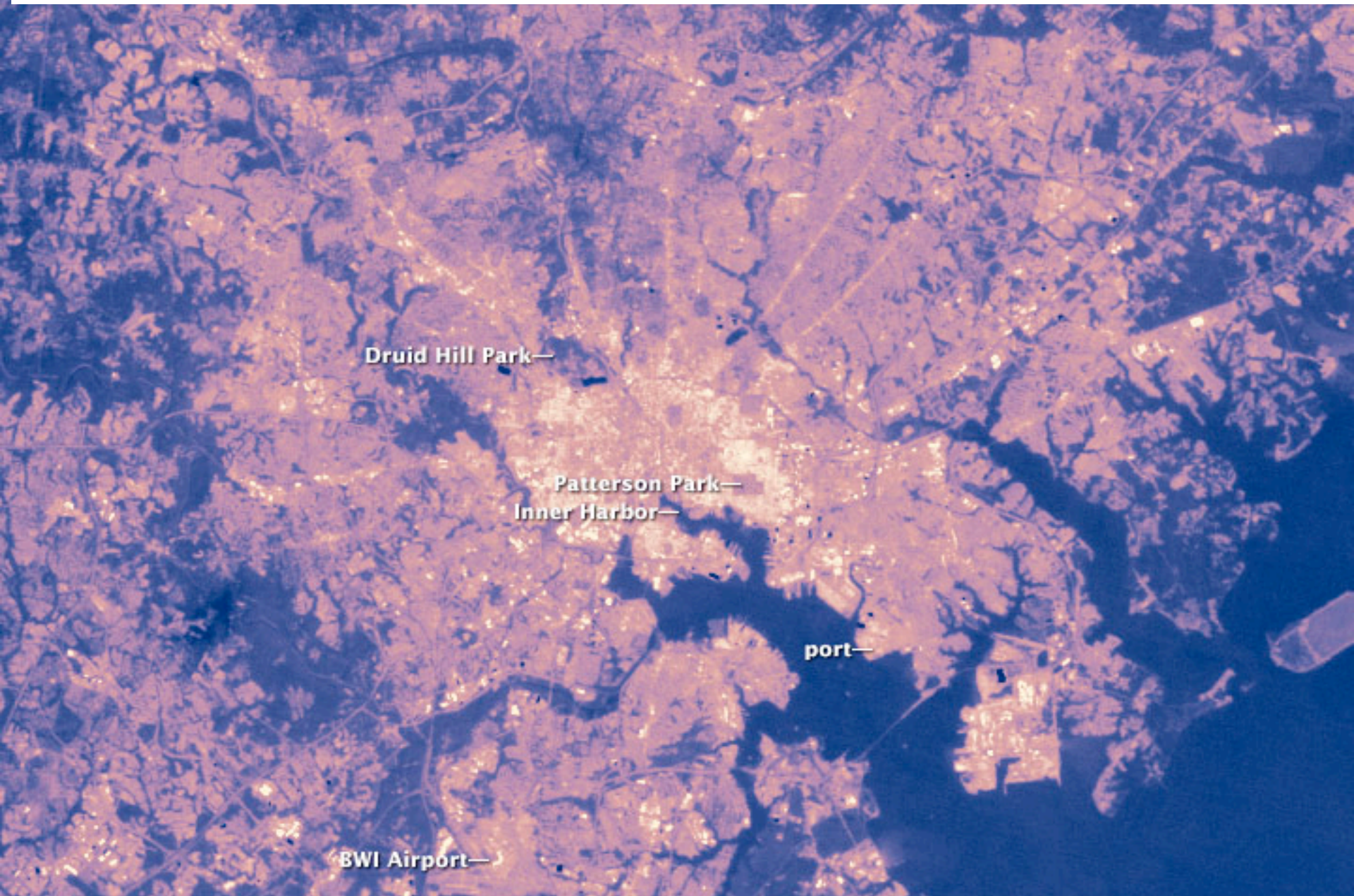


# What causes urban heat islands?

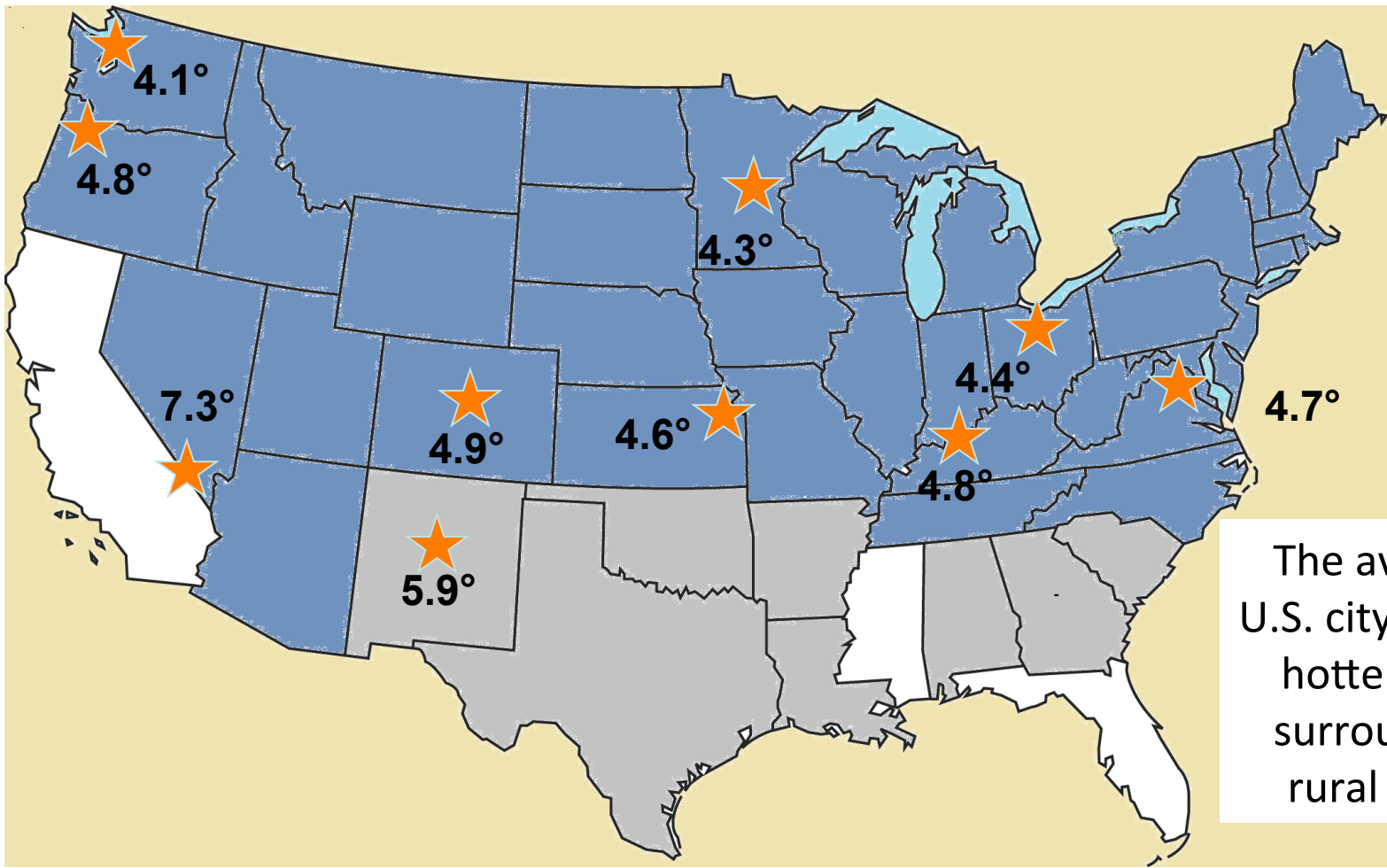


Source: NASA

# What causes urban heat islands?

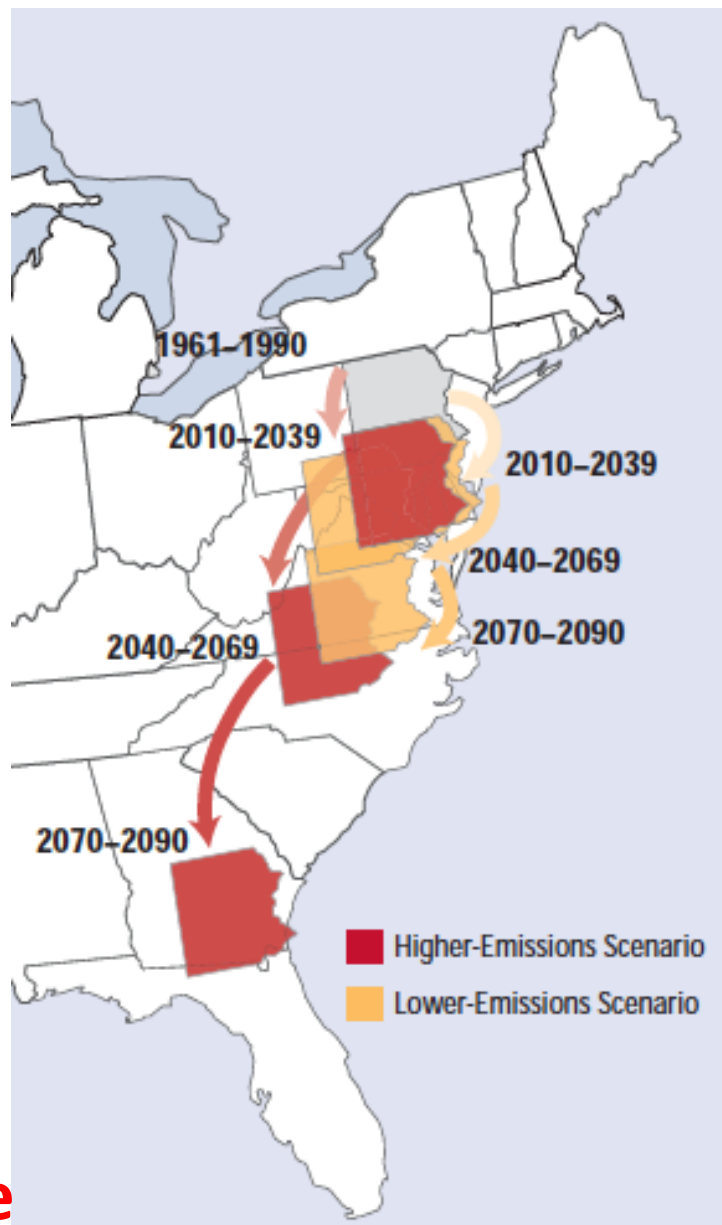
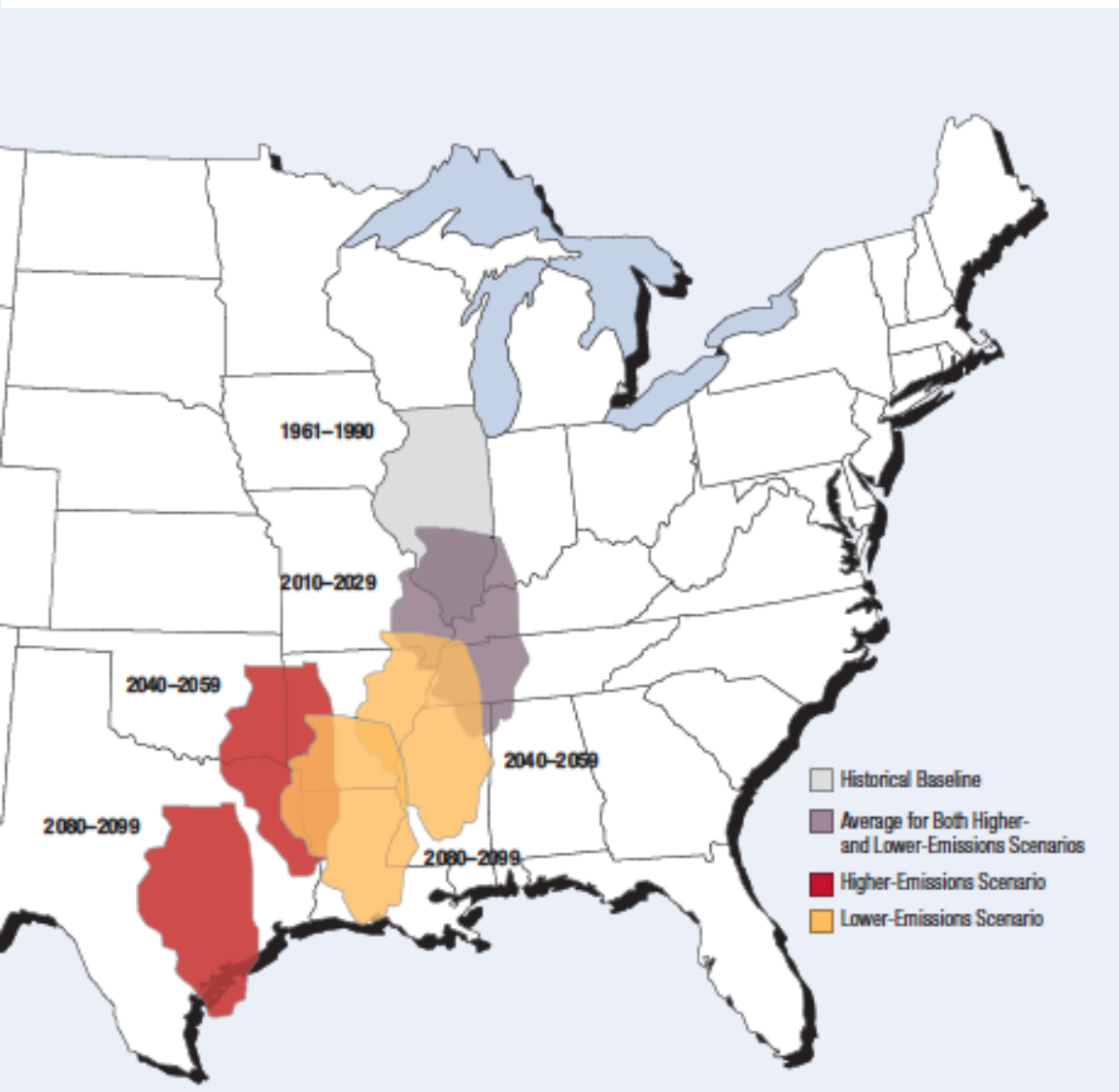


# Top 10 most intense UHIs in the U.S.



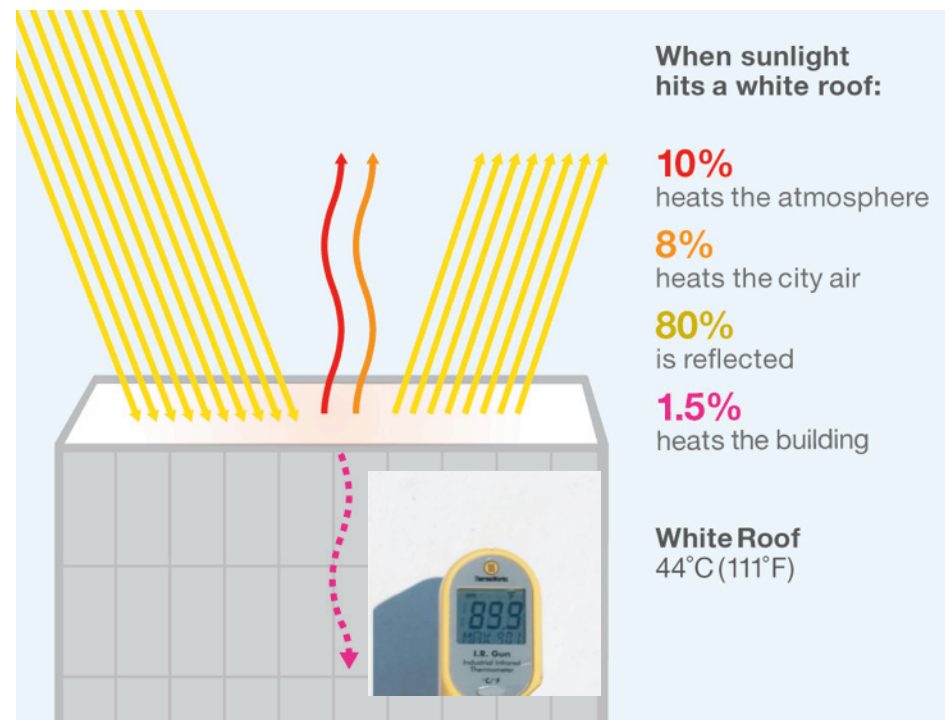
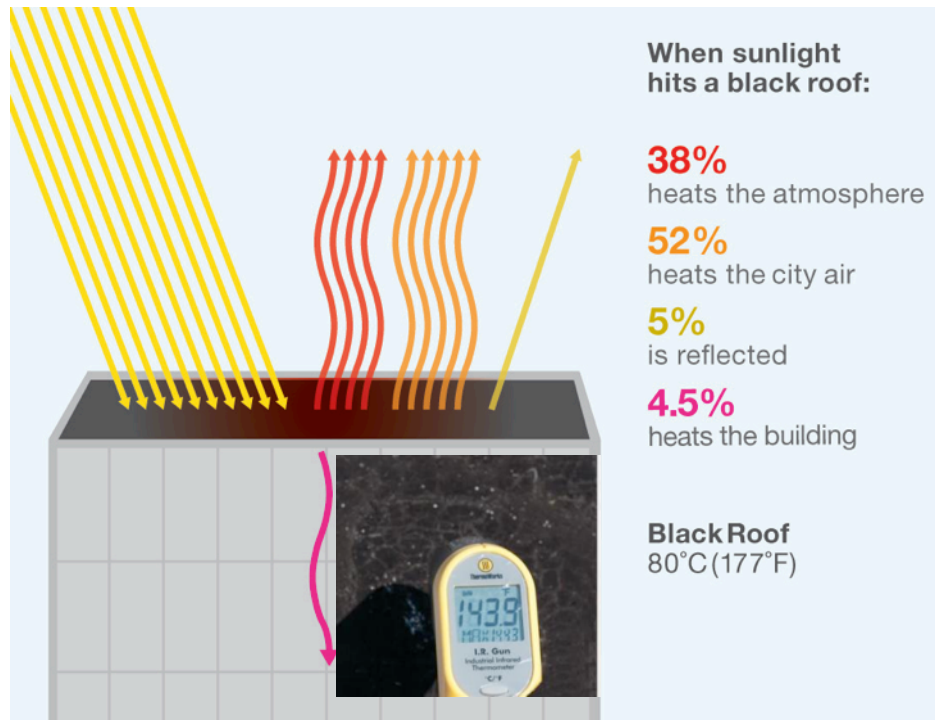
The average U.S. city is **2.7°F** hotter than surrounding rural areas

# Urban heat is worsened by global climate change...



...and growing at 2x the global average

# How reflective “cool” surfaces work



Air Temperature 37°C (99°F)



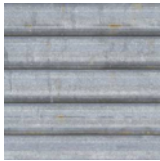
# All sorts of roof types and colors are cool

Standard Concrete Tiles (SR)

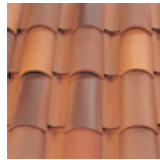
0.04	0.18	0.24	0.33	0.17	0.12
0.41	0.44	0.44	0.48	0.46	0.41

With Cool Coating Applied (SR)

Source: Adapted from data from American Rooftile Coatings.



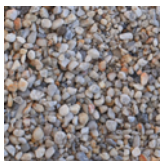
**Metal Roofs**



**Clay & Concrete Tiles**



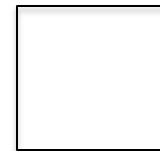
**Coatings**



**Built-Up Roofs**

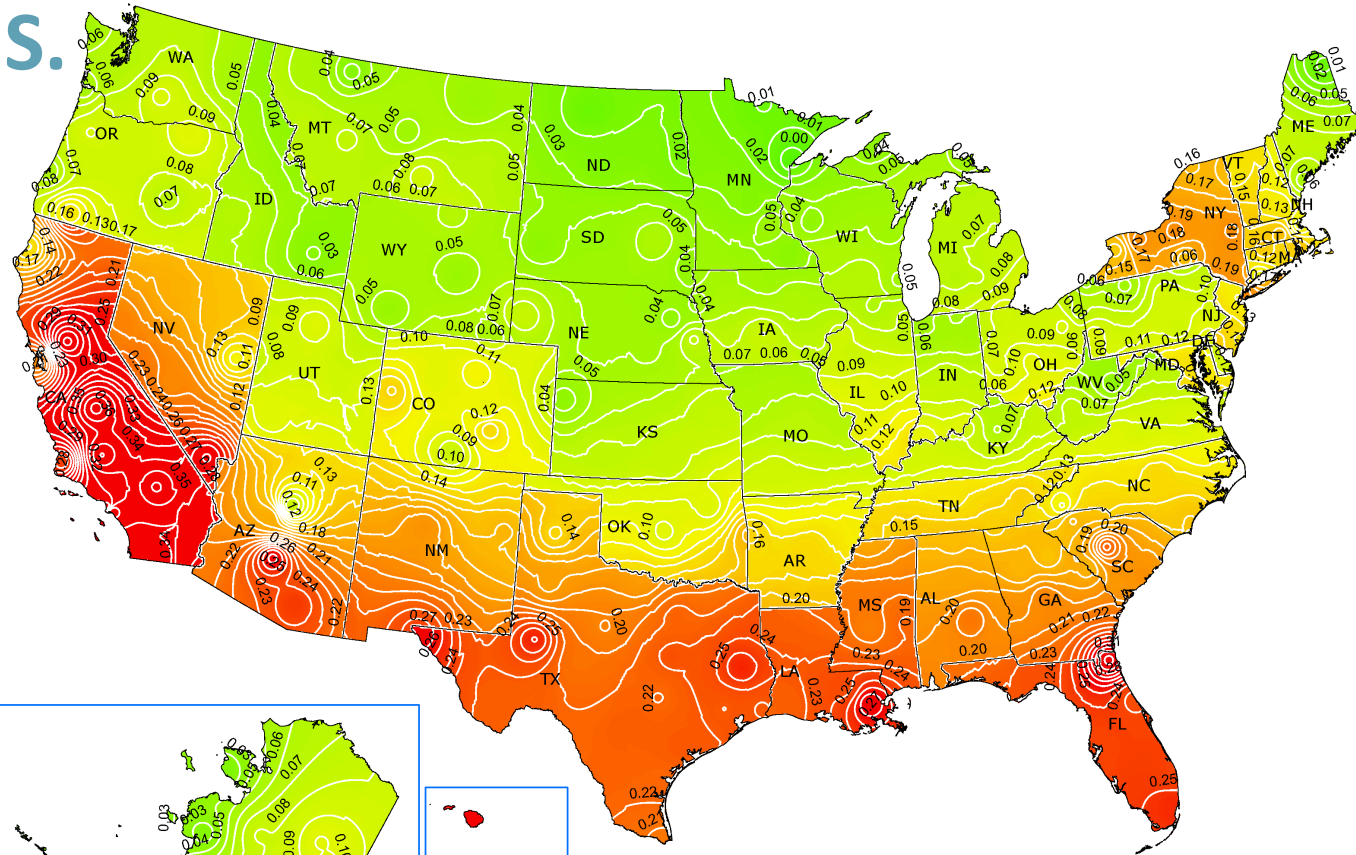


**Asphalt Shingles**

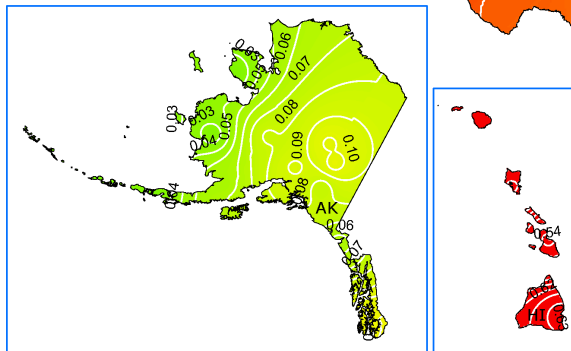


**Membranes**

# Cool roofs generate net energy cost savings across the U.S.

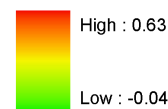


R-19 roof  
R-13 walls  
EER10 A/C



new office annual energy-cost saving

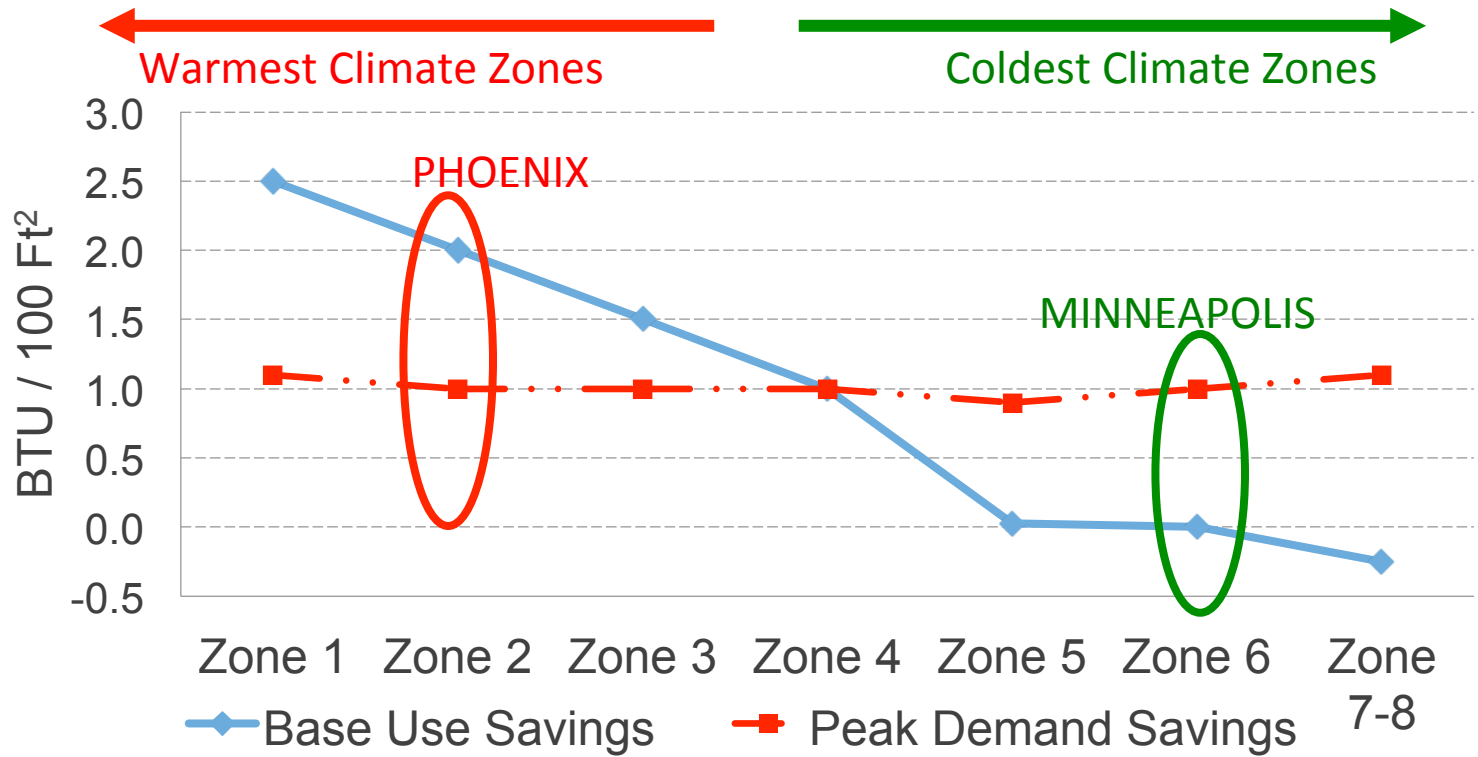
$\$/m^2$



Source: Levinson and Akbari. (2010)

[Potential benefits of cool roofs on commercial buildings: conserving energy, saving money, and reducing emission of greenhouse gases and air pollutants.](#)

# Peak Demand Savings: Uniform Across Climates



## Potential Roof-Related Base Use and Peak Demand Savings (by North America Climate Zone)

COMPARISON	Cool compared to Conventional	Green compared to Conventional	Conventional w/ PV (PPA) compared to Conventional	Conventional w/ SHW (PPA) compared to Conventional
<b>COSTS</b>	<b>\$0.62</b>	<b>\$22.61</b>	<b>\$0.00</b>	<b>\$0.00</b>
<u>First cost</u>	\$0.25	\$15.00	N/A	N/A
<u>Stormwater BMP review fee</u>	N/A	\$0.02	N/A	N/A
<u>Operations and maintenance</u>	\$0.23	\$7.59	N/A	N/A
<u>Additional replacements</u>	\$0.14	\$0.00	N/A	N/A
<b>BENEFITS</b>	<b>\$4.60</b>	<b>\$60.89</b>	<b>\$69.17</b>	<b>\$124.68</b>
<u>Energy</u>	\$0.53	\$2.48	\$2.49	\$48.73
<i>Direct energy savings</i>	\$0.40	\$2.35	N/A	N/A
<i>Indirect (UHI) energy savings</i>	\$0.13	\$0.13	N/A	N/A
<i>Energy generation</i>	N/A	N/A	\$2.49	\$48.73
<u>Stormwater</u>	N/A	\$53.56	N/A	N/A
<i>Fee discounts</i>	N/A	\$1.09	N/A	N/A
<i>SRC revenue</i>	N/A	\$52.47	N/A	N/A
<u>Health</u>	\$4.01	\$4.03	\$52.10	\$27.88
<i>Ozone</i>	\$1.99	\$1.69	N/A	N/A
<i>PM2.5</i>	\$1.41	\$1.72	\$52.10	\$27.88
<i>Heat-related mortality</i>	\$0.61	\$0.61	N/A	N/A
<i>Climate change</i>	\$0.06	\$0.83	\$14.58	\$48.08
<b>NET TOTAL</b>	<b>\$3.98</b>	<b>\$38.28</b>	<b>\$69.17</b>	<b>\$124.68</b>

Roof Technology	Cool roof	Green roof	Rooftop PV	Solar hot water
Internal Rate of Return	77%	11%	N/A	N/A
Simple Payback (years)	2	11	N/A	N/A
Benefit-to-Cost Ratio	7.43	2.69	N/A	N/A
Net Present Value	\$3.98	\$38.28	\$69.17	\$124.68

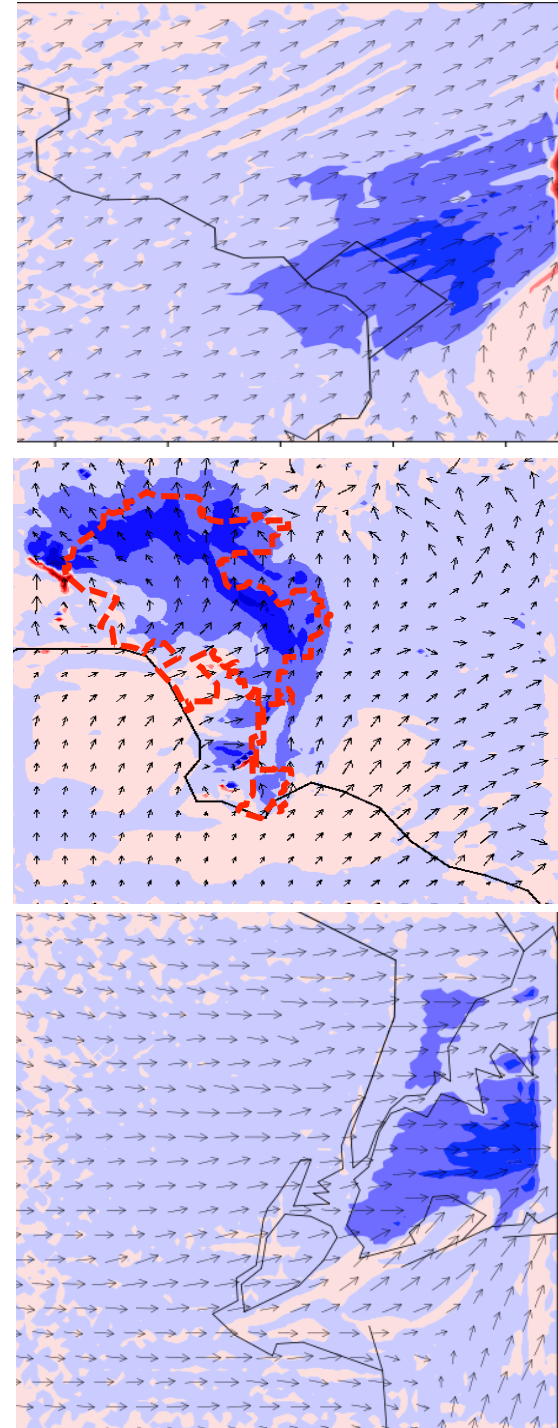
A 10%  $\uparrow$  in surface reflectivity and vegetation cut **outside** temperatures by:

DC: **0.5°F**, leading to a **7%** mortality reduction

LA: **0.5°F**, leading to a **1%** mortality reduction

NYC: **0.3°F**, leading to a **9%** mortality reduction

Baltimore: : **0.5°F**, leading to a **2%** mortality reduction

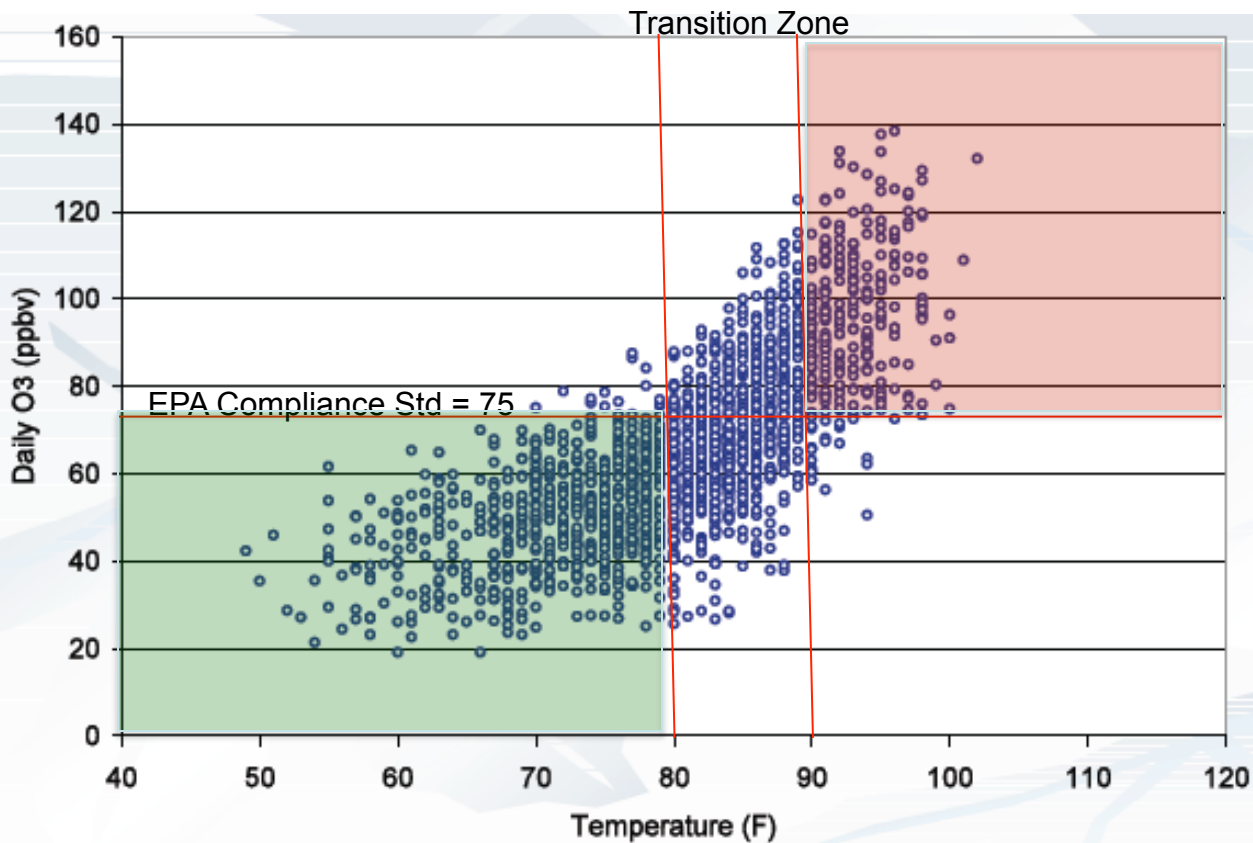


## Cooling with reflectivity: A real-world case



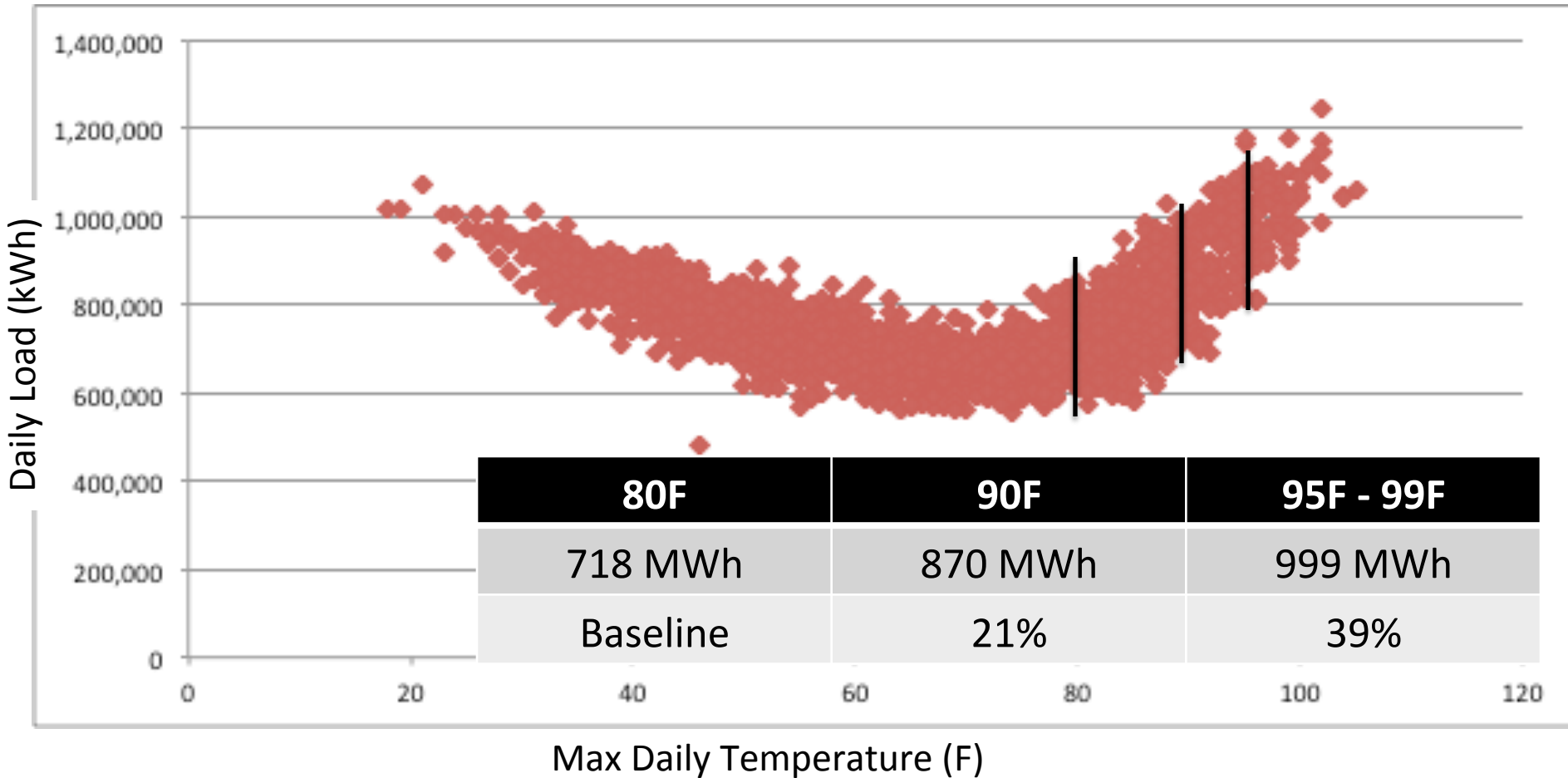
The whitewashed greenhouses of Almeria, Spain have cooled the region by 0.8 degrees Celsius each decade compared to surrounding regions, according to 20 years of weather station data.

# A little cooling goes a long way...



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).

# A little cooling goes a long way (cont)...





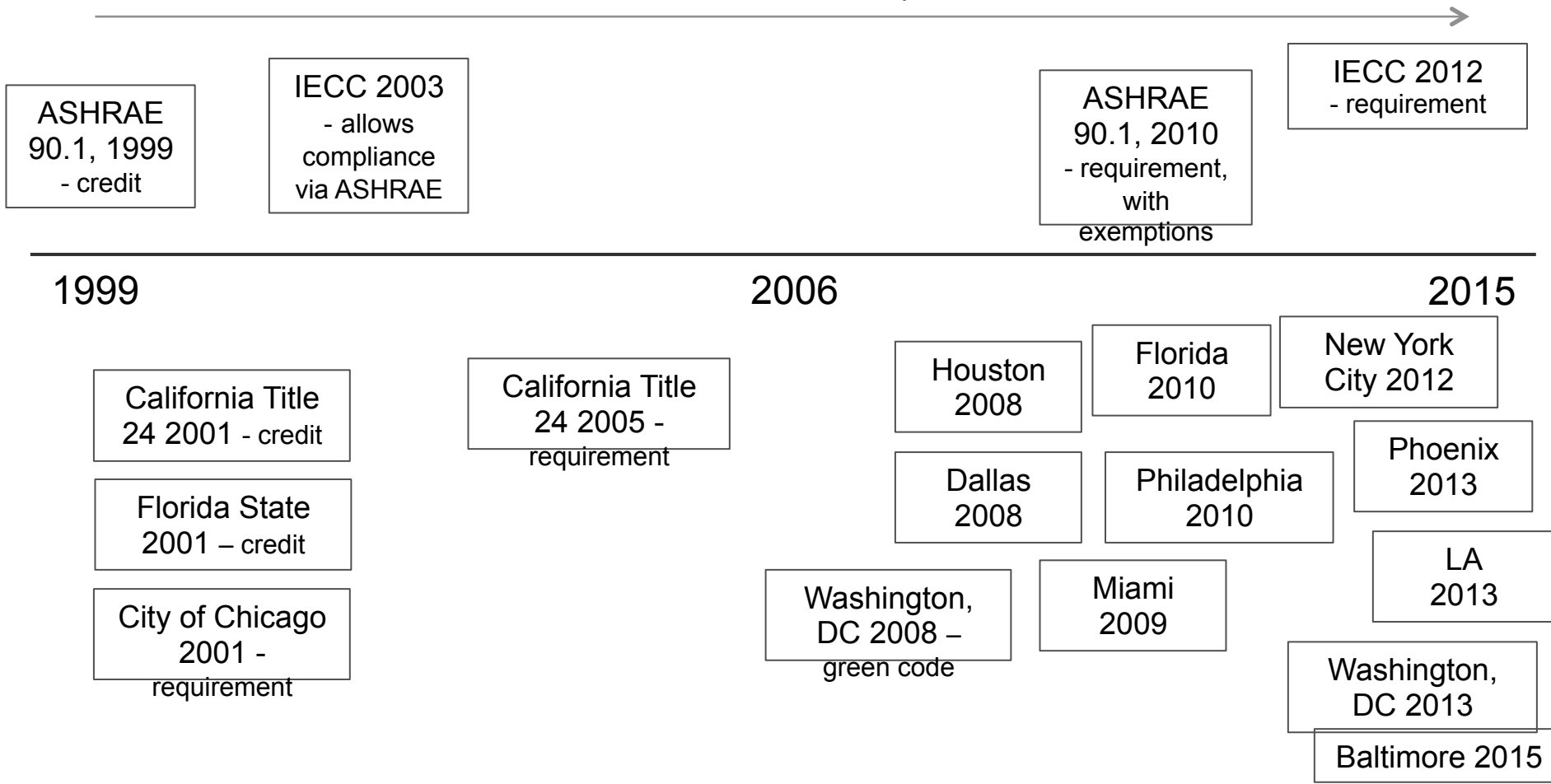
# Global Cooling

- Whitening 1000 ft<sup>2</sup> of grey roof offsets the warming effect of 10 tons of GHGs.
- Total potential is 24 Gt of offsets, or 500 coal power plants worth of emissions, or removing half the world's cars for 20 years.



# Cool Roofs in the Codes

Trend is moving from credits and trade-offs with insulation to requirements





# Thank You!

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