The Cool Roofs and Pavements Toolkit

Welcome!

Introductions

Cool Surface Review

Implementing Cool Surfaces

The Goal: Cleaner and More Resilient Regions

- Homes, schools, warehouses, and offices that are more comfortable and waste less energy.
- Healthier, 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.

R20 Mission

To help states, provinces, regions and other subnational governments around the world develop, implement, and communicate low-carbon, climate-resilient economic development projects, policies, and best practices.

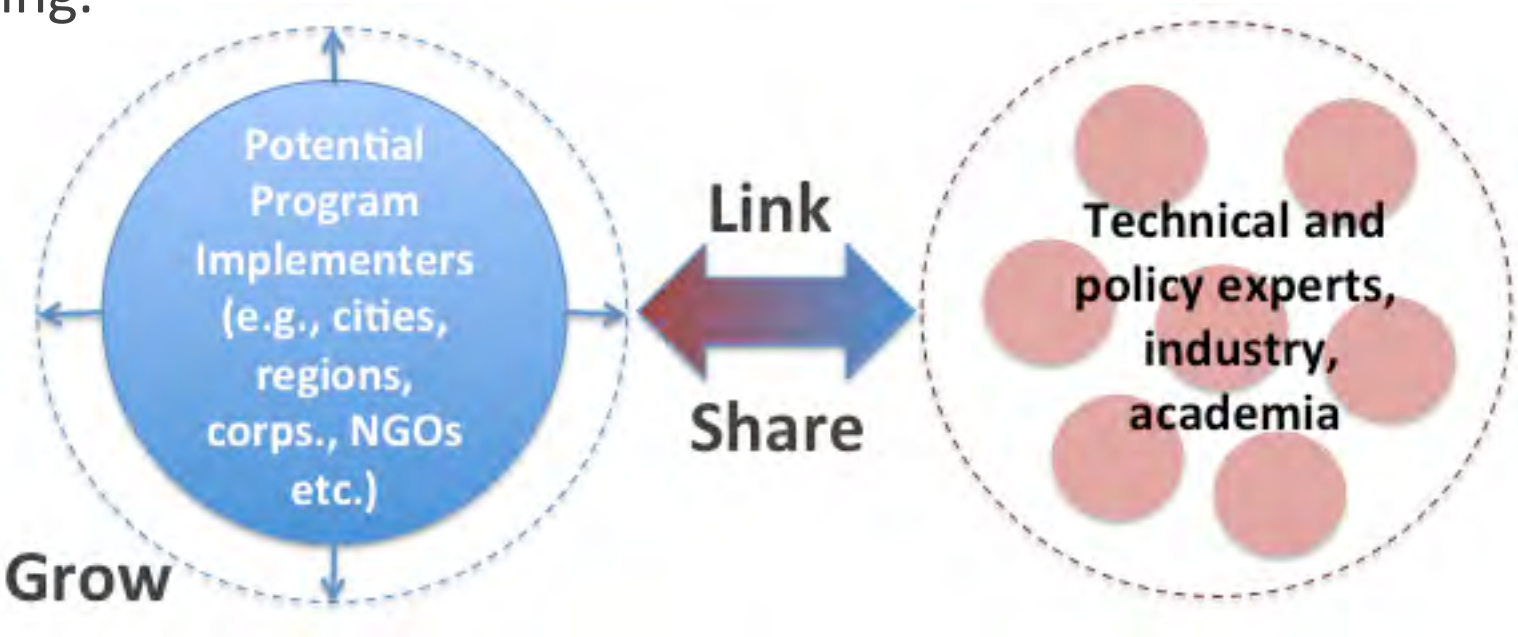
Regions 20 and GCCA

GCCA is R20's technical advisor on cool surfaces and urban heat island mitigation strategies.

The Toolkit is a joint effort to help R20 members launch successful initiatives to reduce urban heat.

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.



The Cool Roofs and Pavements Toolkit – www.CoolRoofToolKit.org

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

Let's Get Started

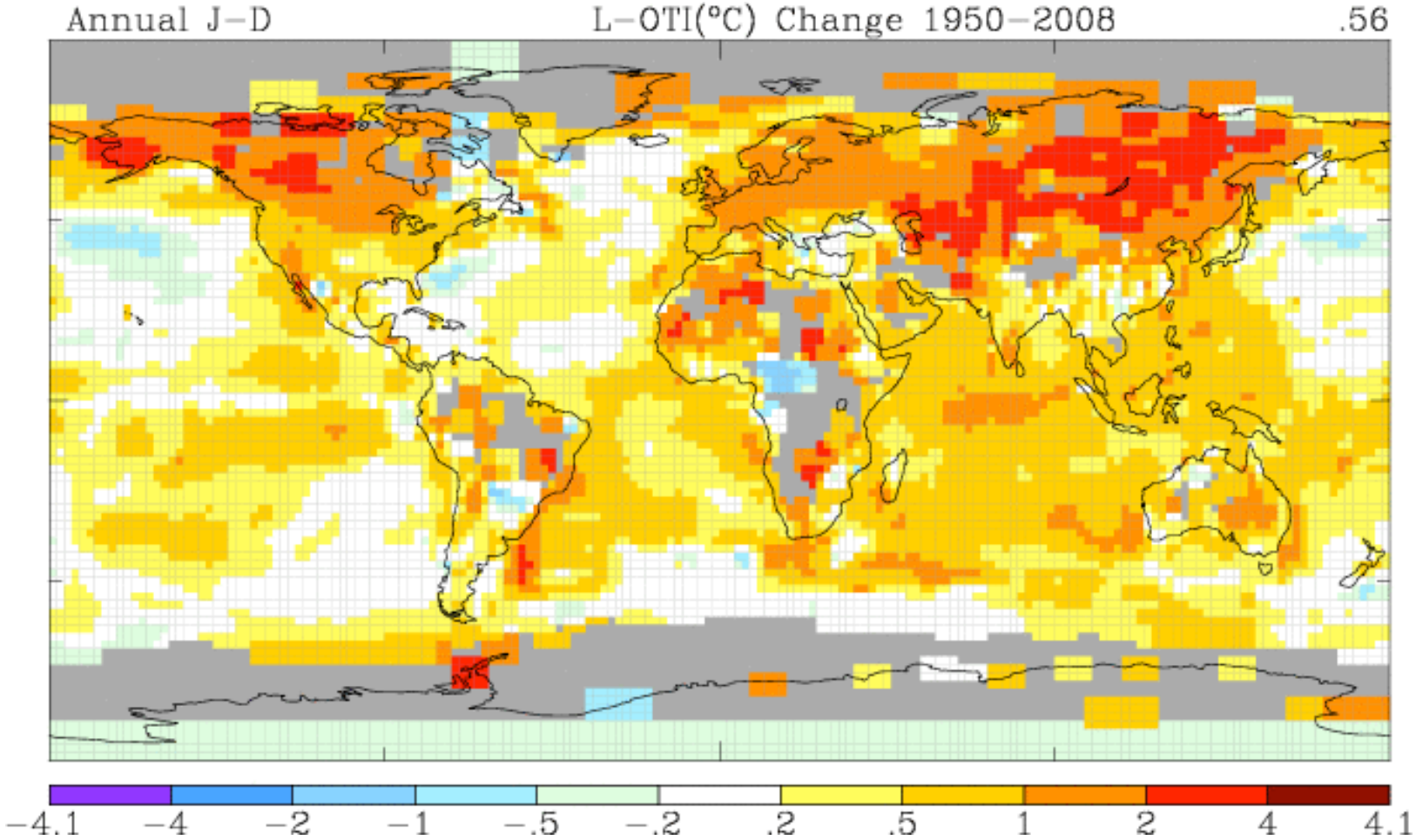
The Problem with Urban Heat

How Cool Surfaces Work

Benefits

Urban Heat Island Mitigation Strategies

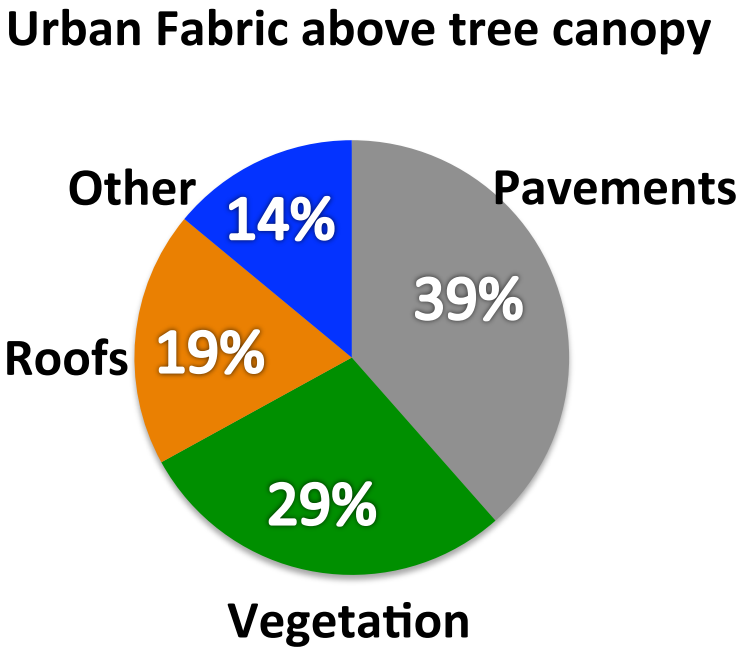
The Planet is Warming



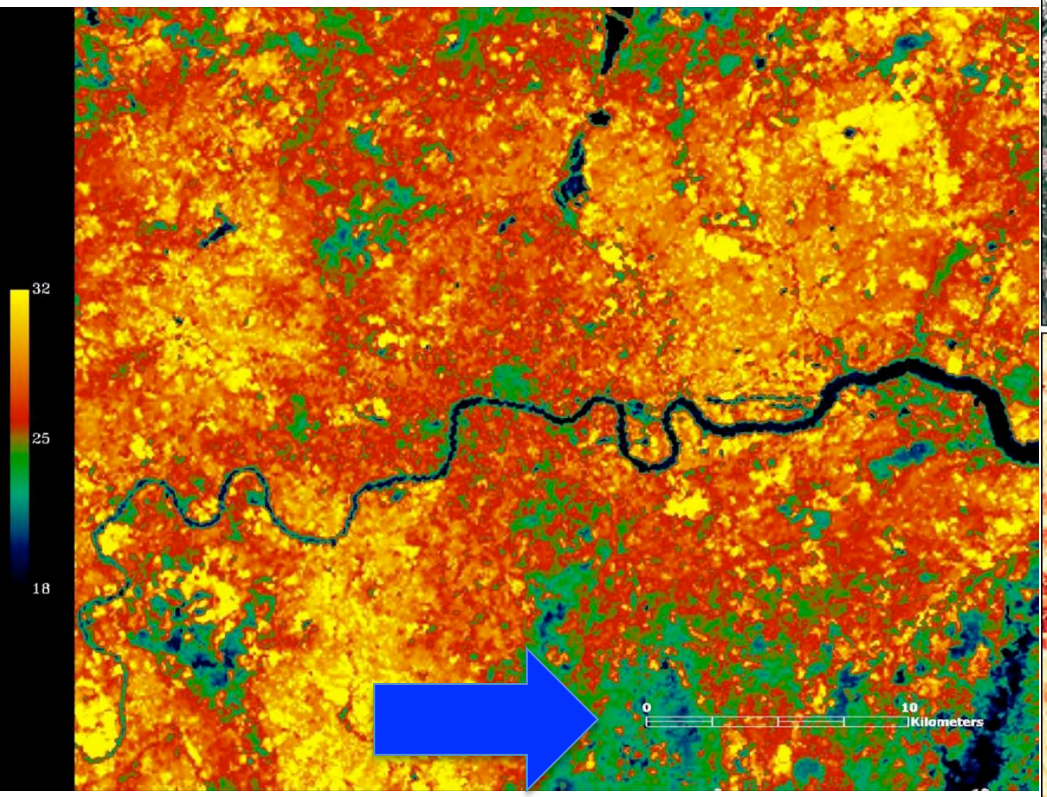
Source: NASA

Especially in cities, thanks to the urban heat island effect

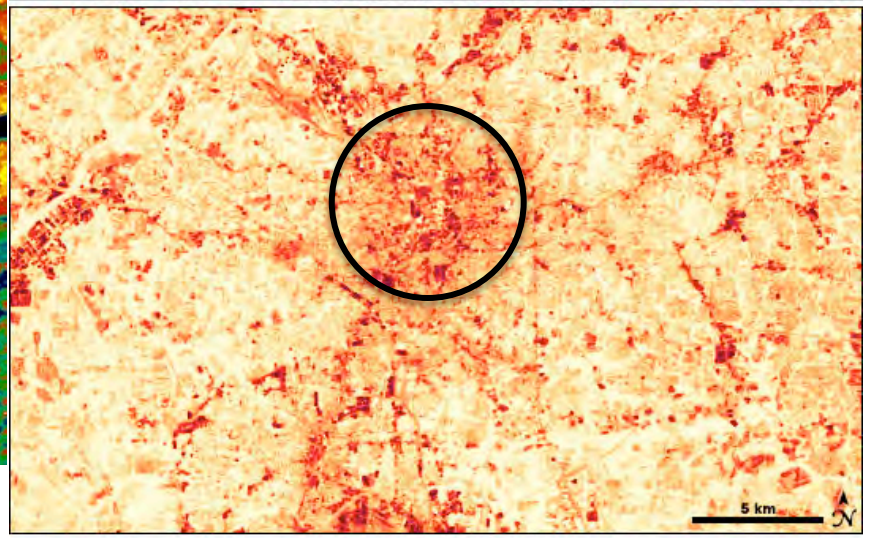
- Human activity, combined with dark roofs and pavements, make cities hotter than surrounding rural areas.
- Higher temperatures lead to greater energy use, lower air quality, and a reduced quality of life in urban areas.

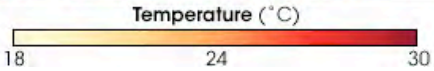


Some Examples



Source: NASA ASTER



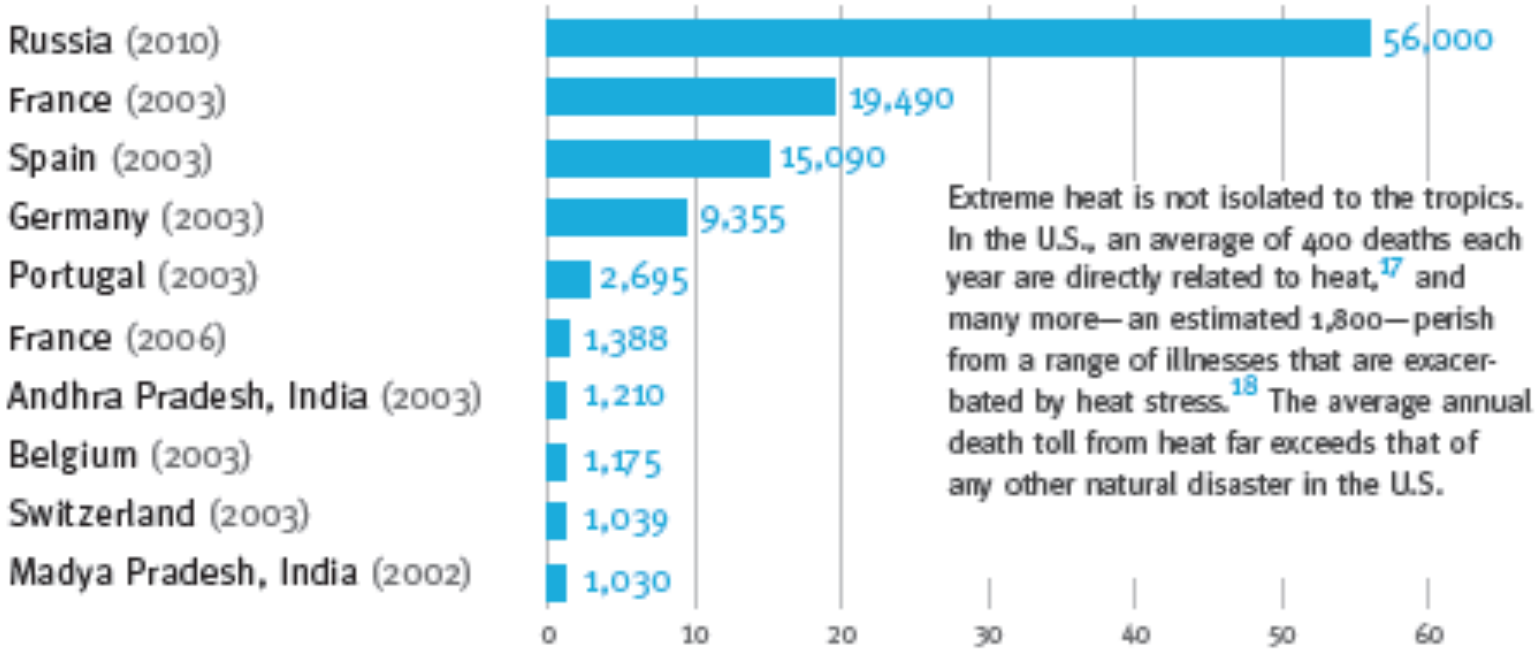


Source: NASA

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

Thank you for participating!

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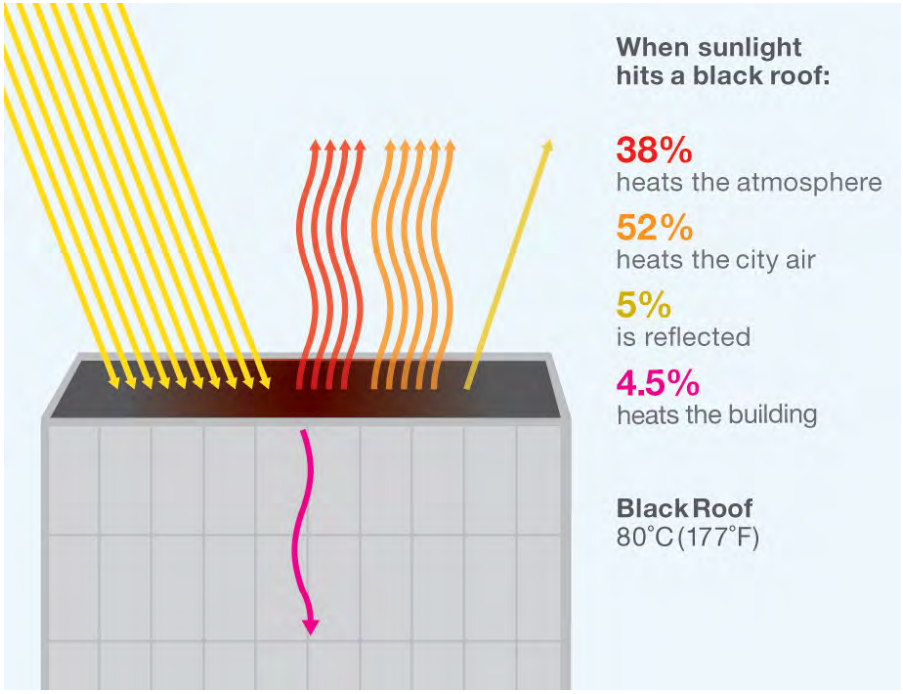
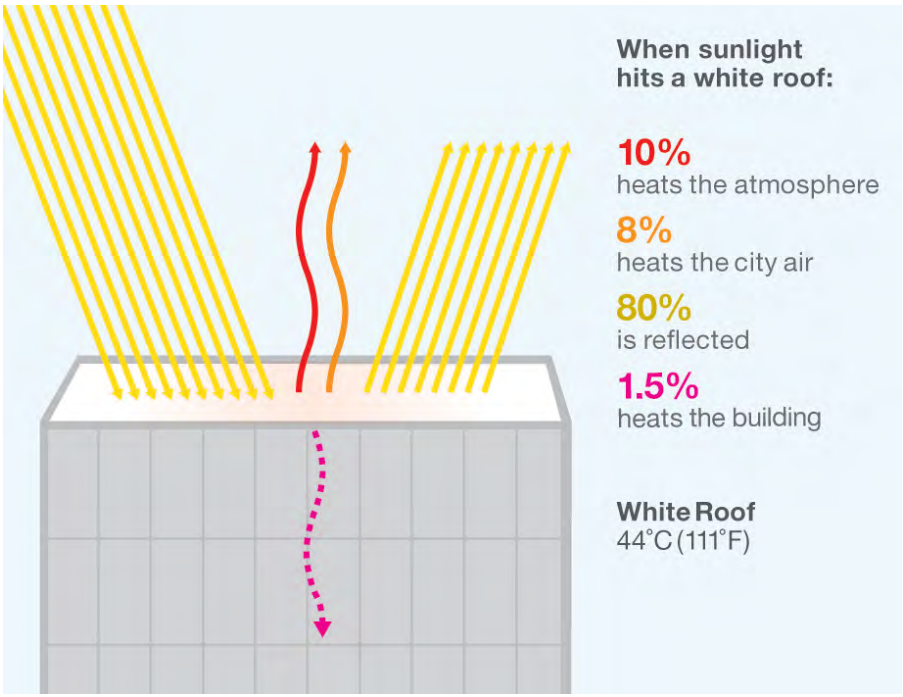
How Cool Roofs Work



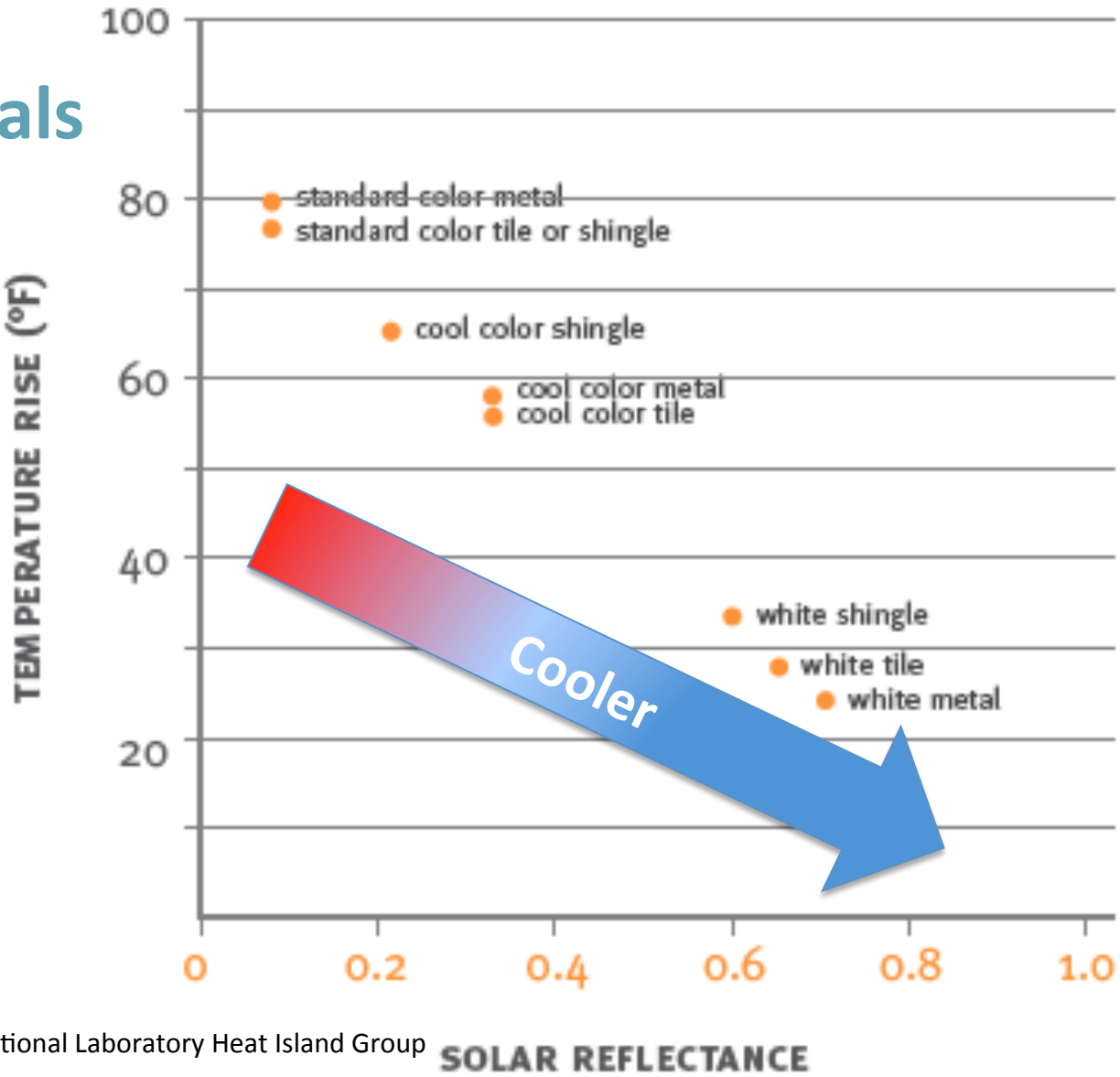


Air Temperature 37°C (99°F)

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

Cool Materials

Reflectance of common roofing materials and the temperature increase above ambient.

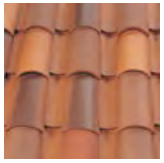


Source: Lawrence Berkeley National Laboratory Heat Island Group

Example Roof Types

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.

Winter Heating Penalty

Annual Net Energy Cost Savings in Various U.S. Cities from Widespread Use of Cool Roofing

As the chart indicates, cool roofs create net energy cost savings even in northern U.S. cities with long cold winters. This graph shows that cool roofs are cost-justifiable based on energy impacts alone — it does not capture the potentially significant cost savings gained from lowering incidences of heat and pollution-related illness and death, increased productivity of workers in more thermally comfortable facilities or other societal benefits.

Cooling Savings

Net Savings

Values are in 2003 dollars per 1000 ft²

Average Savings (in USD)

Source: Adapted from Dallas Urban Heat Island, Houston Advanced Research Center, 2009. sciencedirect.com/science/article/pii/S0360544298001054

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 Pavements

- Pavements are a major part of the urban fabric – nearly 40%.
- Research ongoing on permeable and high-albedo pavement materials and technologies.

Thank you for participating!

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Addressing Urban Heat Islands Help to Achieve Goal of Sustainable and Resilient Urban Areas

Building Scale

- Up to 20% reductions in cooling demand on top floor.
- Improved thermal comfort and productivity in unconditioned buildings (e.g., homes, warehouses etc.).
- Longer lasting roofs.

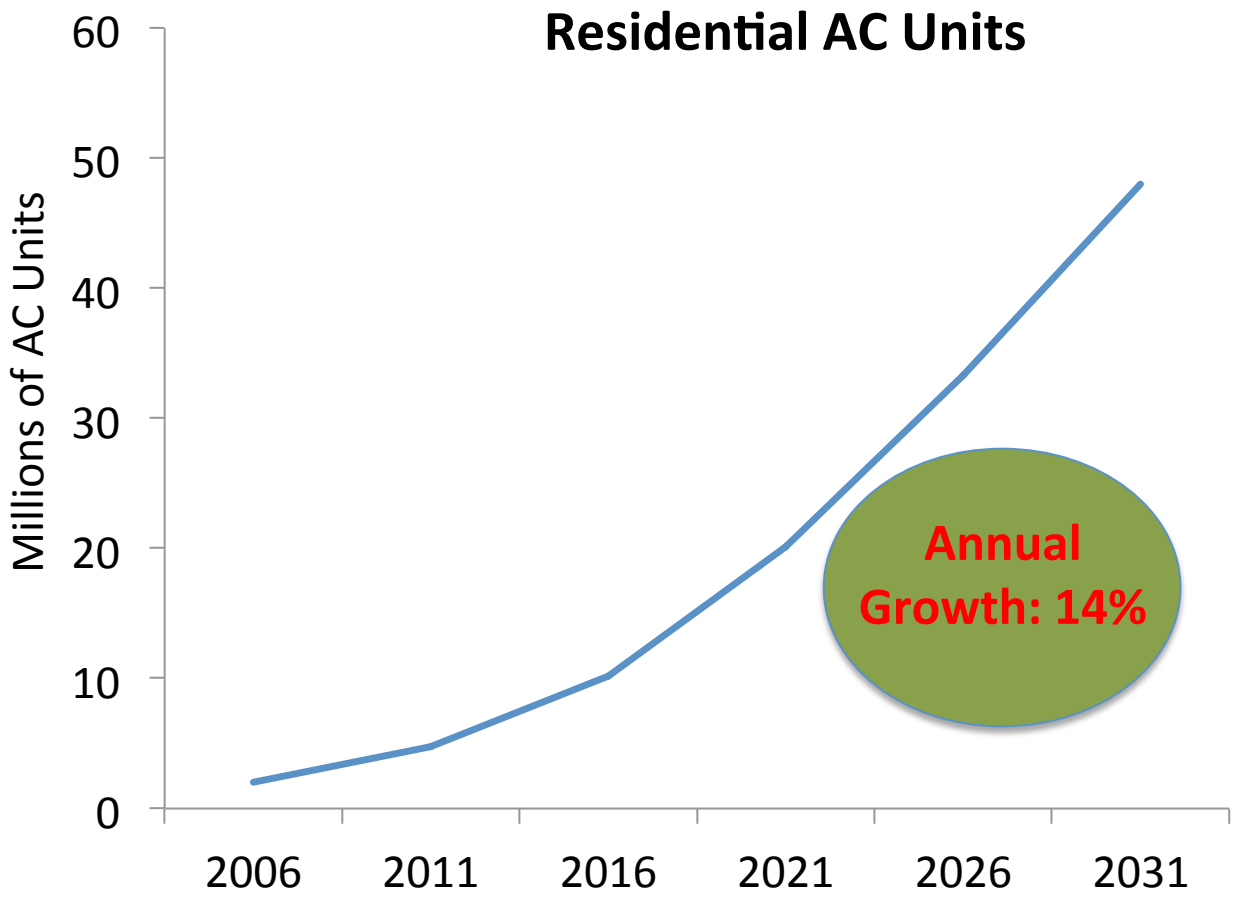
Urban Scale

- Improved air quality – a $10 billion energy and health cost reduction opportunity in the U.S. alone.
- Reduced peak electricity demand and avoided adoption of air conditioning.
- Greater resiliency to heat events and climate change.

Global Scale

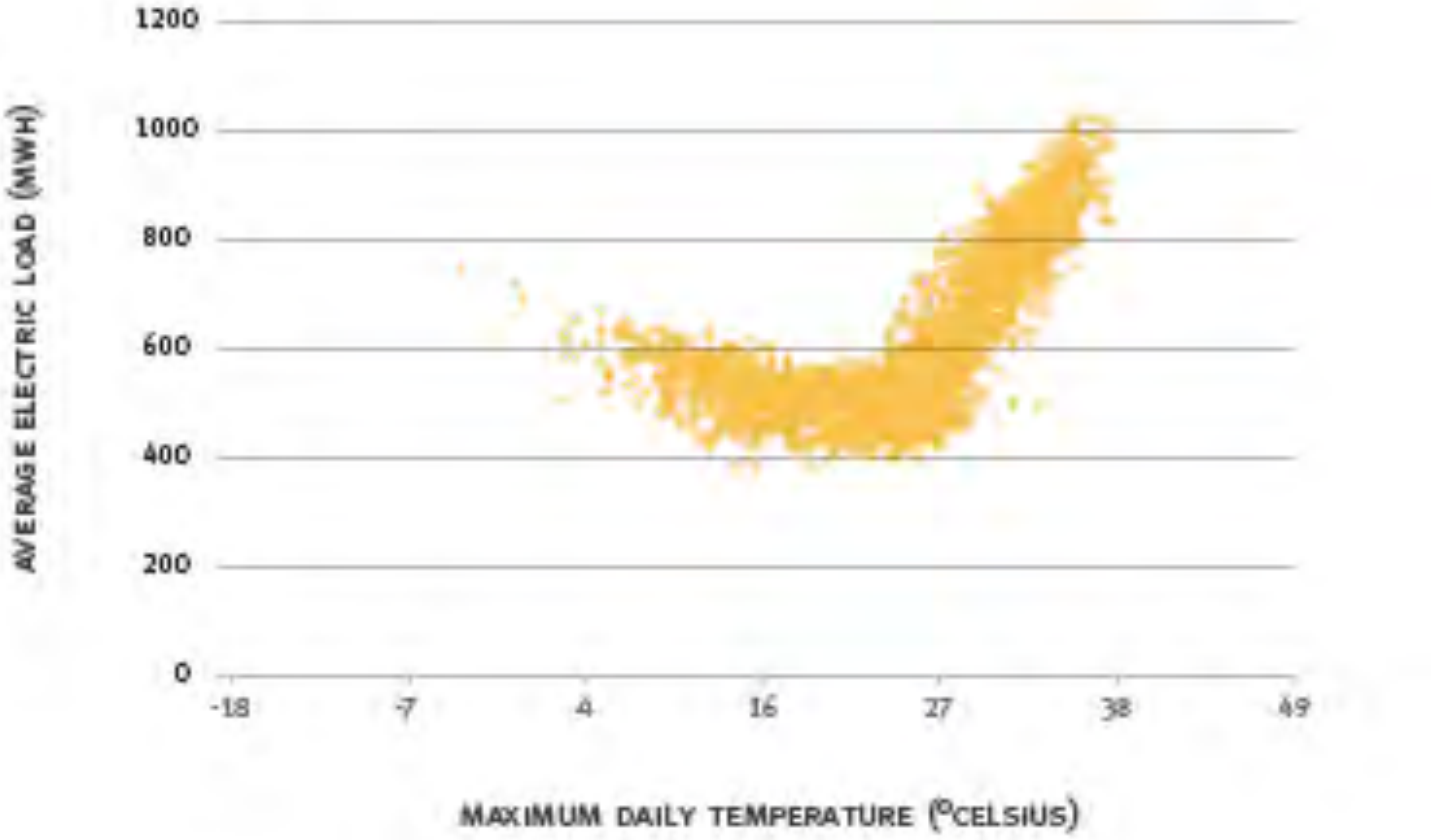
- Offset the warming effect of 24 gigatons of CO_2 – equivalent to taking 500 coal power plants offline for 20 years.
- Every 10 square meters of white roof = 0.5 tons of CO_2 offset per year.

New AC Load: India



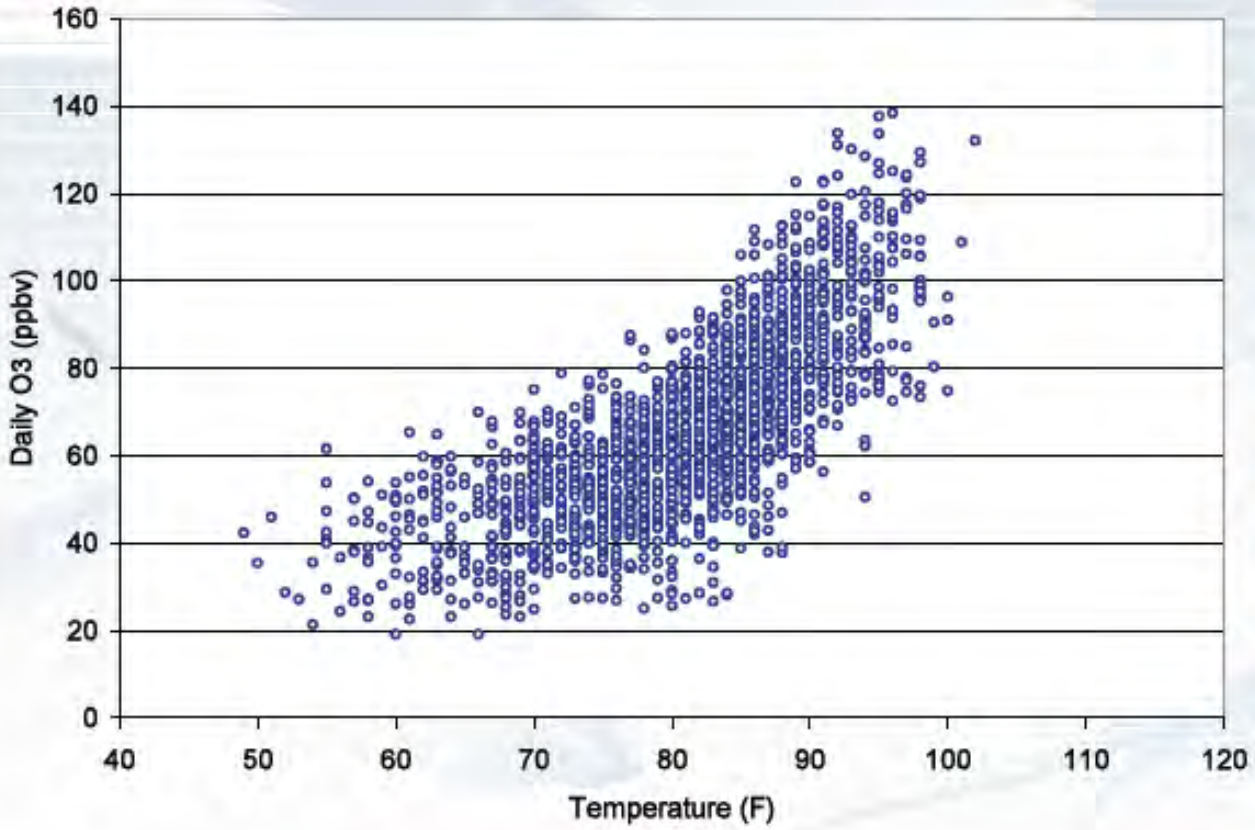
Source: World Bank

Electricity Load and Temperature



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.

Smog Formation and Temperature



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).

Source: Maryland Commission on Climate Change

A Real-World Example of Global Cooling

Source: Google Earth

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.

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Roadmap for implementation

Policies
(e.g., codes, ordinances, incentives)

Programs
(e.g., demonstrations, volunteer efforts, workforce training)

Foundation Activities
(e.g., information gathering, building support and capacity)

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Foundation Activities

Identify existing activities

Key actions:

- ☐ Identify existing climate/sustainability plans for your city, state, or region.
- ☐ Research existing building and energy codes, laws, and incentives.
- ☐ Review aerial and satellite imagery to determine penetration of cool surfaces.
- ☐ Review thermal maps to identify urban heat centers.

Key questions:

- Are cool surfaces a part of existing strategic plans, codes, laws, or incentives?
- To what extent have cool materials been widely deployed in my region to date?
- Are any high profile buildings already cool?

Foundation Activities

Key actions:

- ☐ Identify weather and air quality data files as well as building construction and pavement characteristics.
- ☐ Work with utilities/grid operators to secure energy use and pricing data and compare to temperature data.
- ☐ Engage local contractors, distributors, and manufacturers to determine availability of cool products.
- ☐ Develop the economic case for cool surfaces, including the impact of heat- and pollution-related death and illness.

Assess local potential

Key questions:

- What types of buildings and pavements are in my area?
- What climate zone am I in and what are common weather patterns?
- What is the cost and demand for energy (electricity and gas) in my area?
- What is the market availability of cool products locally? Are local professionals aware of and trained on cool materials?

Foundation Activities

Build local support and capacity

Key actions:

- ☐ Find supporters and attract funding. (Start early!)
- ☐ Identify technical resources locally and globally.
- ☐ Join or leverage existing memberships in city/regional organizations.
- ☐ Develop local training and education programs.

Key questions:

- How can cool roofs and pavements champions and stakeholders be identified and organized?
- How can we fund activities and programs?
- What existing resources and networks are available for technical support, training, and best practices?

Roadmap for implementation

Policies
(e.g., codes, ordinances, incentives)

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(e.g., demonstrations, volunteer efforts, workforce training)

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(e.g., information gathering, building support and capacity)

Cool Programs

Design and launch Programs

Such as:

- ☐ Awareness raising/marketing campaigns
- ☐ Education and training programs
- ☐ Demonstration projects
- ☐ Volunteer programs
- ☐ Contests

Best practices:

- ☐ Design demonstration projects that build local performance data and engage the public.
- ☐ Work with industry to encourage program sponsorship or the donation of in-kind support.
- ☐ Use volunteer installation programs to raise public awareness and target buildings underserved by the market.
- ☐ Measure the success of programs both quantitatively and qualitatively.

Education and Training are Key!

- Training multiplies efforts by creating new qualified stakeholders
- Raising awareness of the general public
- Capacity building for local technical institutions
- Practical training for architects, developers, and contractors (especially when codes are in the picture!)

The Toolkit includes links to helpful training resources and examples

Roadmap for implementation

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(e.g., codes, ordinances, incentives)

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(e.g., demonstrations, volunteer efforts, workforce training)

Cool Policies

Enact cool policies

Such as:

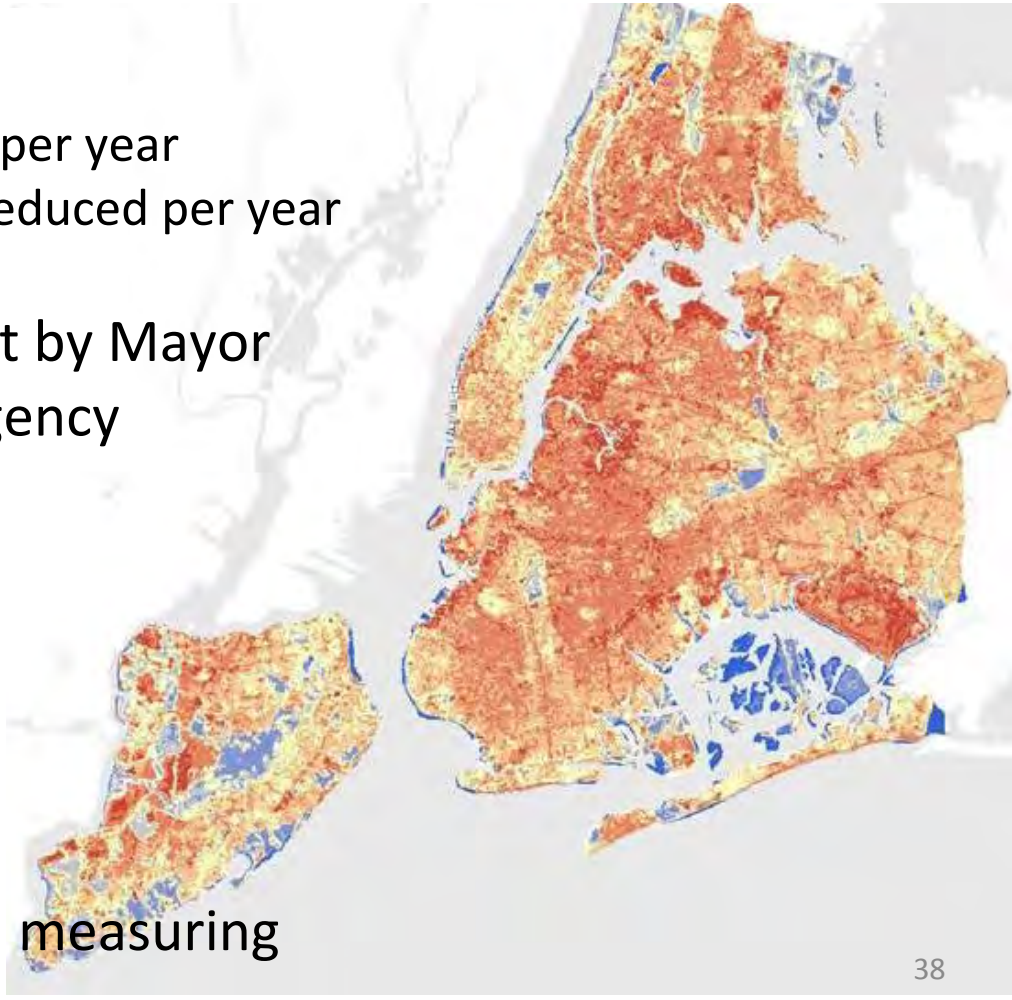
- ☐ Code and ordinance adoption
- ☐ Support for code enforcement
- ☐ Incentives (rebates, volume discounts, loans)
- ☐ Government procurement policies

Best practices:

- ☐ Assess local applicability of existing cool roof standards, codes, and laws.
- ☐ Understand the code-making process and identify partner agencies.
- ☐ Build the case for change and secure broad support.
- ☐ Ensure monitoring and enforcement.
- ☐ Work with officials and utilities to develop incentives.
- ☐ Include cool surface requirements in procurement specifications.

I Love New York!

- Goal: Cool NYC by 1 degree
  - $100M in energy cost savings per year
  - 300K tons of GHG emissions reduced per year
- High-level, public commitment by Mayor Bloomberg backed by inter-agency coordination
- Robust volunteer efforts
- Cool roof ordinance
- Innovations in monitoring and measuring



How can we help you?

While there is plenty to be gained from the experience of others, each region will have slightly different challenges, solutions, and opportunities.

What are your sustainability/resiliency goals?

What obstacles challenge your goals?

What initiatives are already underway?

Does a focus on urban heat island mitigation make sense for you?

Thank You!

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