

# A Practical Guide to Cool Roofs and Cool Pavements Executive Summary

Read *A Practical Guide to Cool Roofs and Cool Pavements* at: [www.CoolRoofToolkit.org](http://www.CoolRoofToolkit.org)

## World temperatures are rising at an unprecedented rate.

According to the Intergovernmental Panel on Climate Change, the Earth's average temperature is on track to increase by between 2 and 7 degrees Celsius (4 to 13 degrees Fahrenheit) this century. This dramatic change in temperature will produce a climate never before experienced by human civilization. Cities are often significantly warmer than the surrounding landscapes due to the summer "urban heat island effect." Addressing this heating effect will only become more important because the world is rapidly urbanizing—within 50 years an estimated 80 percent of the world's population will live in an urban area.<sup>1</sup>

## Higher temperatures adversely affect our health, our energy consumption, and our environment.

Rapidly increasing temperatures stress ecosystems, increase the frequency and duration of heat waves, and exacerbate air pollution. Together, these factors are creating serious health risks to people around the world. In addition, increasing wealth in the developing world is spurring the rapid deployment of air conditioners which burden electrical grids with their energy demands.

**Cool roofs and pavements can help cool down buildings and cities.** Replacing roofs and pavements with more reflective materials could reverse the urban heat island effect. Cool, reflective roofs and pavements are readily available, typically pay back within one year when the roof is ready to be replaced, and help cities both mitigate and adapt to climate change while making them more desirable and comfortable places to live.

## Benefits of cool buildings\*

- Cooling energy savings of 10 to 20 percent on the top floor of the building by reducing air conditioning needs—a cost savings potential of \$735 million per year in U.S. commercial buildings alone<sup>2</sup>
- More comfortable indoor air temperatures
- More comfortable and functional for residents of regions where the roof is used as living space
- Likelihood of improved roof and equipment life due to reduced thermal expansion
- Cost-effective investment versus a traditional technology that often pays back immediately when a roof is going to be replaced anyway

## Benefits of cool cities

- Better air quality—an annual economic benefit of nearly \$1 billion annually in the U.S.<sup>3</sup>
- More resistant to heat and pollution related illness and death
- Reduced peak energy demand
- Healthier, more comfortable and enjoyable urban spaces

## Benefits to the planet

- Avoids CO<sub>2</sub> emissions by reducing cooling demands
- Offsets the warming effect of approximately 1 year's worth of global CO<sub>2</sub> emissions<sup>4</sup>

There are straightforward policies and programs with proven track records that leaders may adopt to make their regions cooler. Foundational Activities, below, describe the basic requirements to launching successful cool roof and pavement programs. Implementation Activities, also below, describes policies and programs that have been field-tested around the world and shown to be effective at deploying cool surfaces.

\* Reflective materials, appropriate levels of insulation, and good windows make cool buildings more efficient and comfortable than conventional buildings.



Produced by Global Cool Cities Alliance and R20 Regions of Climate Action

[www.CoolRoofToolkit.org](http://www.CoolRoofToolkit.org)

1 Crutzen, P. J. (2004). New directions: The growing urban heat and pollution "island" effect – impact on chemistry and climate. *Atmospheric Environment*, 38(21), 3539-3540.; Akbari, H., Rosenfeld, A., and Menon, S. 2009. Global cooling: Increasing world wide urban albedos to offset CO<sub>2</sub>. *Climate Change*, 94(3-4). 275-286.; Levinson, R., Akbari, H., Konopacki, S. & Bretz, S.E. (2005). Inclusion of cool roofs in non-residential Title 24 prescriptive requirements. *Energy Policy*, 33, 151-170.

2 Levinson, R. & Akbari, H. (2010). Potential benefits of cool roofs on commercial buildings: conserving energy, saving money, and reducing emission of greenhouse gases and air pollutants. *Energy Efficiency*, 3, 53-109.

3 Akbari et al. (2009).

4 Ibid.

# Foundational Activities

Good programs, like buildings, may look very different from one another but all must be built on solid foundations. The Foundational Activities described below cover some of the basic requirements to launching a successful cool roof or pavement program. These steps can be taken in any order, but each is an

important part of developing a popular, measurable, and successful cool roofs and pavements program. The steps described in Foundational Activities should be conducted in advance of beginning implementation activities. Use this checklist to get started.



## Identify existing activities

### 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?

### 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.

### Resources:

- Capital E
- Cool Roof Rating Council
- Dallas and Houston, TX case study
- Database of State Incentives for Renewable Energy
- Energy Coordinating Agency of Philadelphia
- EU Cool Roofs Council
- Global Eco-Cities Survey
- Weatherization Assistance Project
- The White Roof Project

## 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?

### 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.

### Resources:

- Center of Environmental Innovation in Roofing
- ENERGY STAR
- Human Relations Area Files
- NASA Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)
- NOAA National Climatic Data Center
- National Roofing Contractors Associations
- World Meteorological Organization

## Build local support and capacity

### 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?

### 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.

### Resources:

- The Business Council for Sustainable Energy
- The Foundation Center
- GLOBE Alliance
- National Association of Clean Air Agencies and Clean Air World
- Organizations of governments such as R20, ICLEI Local Governments for Sustainability, and C40
- World Green Building Council
- US Green Building Council

# Implementation Activities

Implementation Activities includes two basic approaches: policies and programs. The items in the overview checklist on this page can be undertaken in any order, or conducted in parallel. The most successful initiatives have launched both policies and programs that are mutually

reinforcing. Of course, there is always room for new, creative approaches that speed the deployment of cool roofs and pavements.

We recommend completing foundational activities before getting started with implementation.



## 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.

### Case studies & resources:

- American Institute of Architects
- California Energy Commission
- Case Studies: Toronto, Chula Vista, New York City, Walmart, and Delhi.
- Global Cool Cities Alliance
- Global Eco-Cities Survey
- NYC°CoolRoofs



## 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 building codes officials on permit/process-based incentives.
- Work with taxing entities to explore tax-based incentives.
- Work with utilities to craft rebates.
- Include cool surface requirements in procurement specifications.

### Case studies & resources:

- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- Building Codes Assistance Project
- California Title 24
- DOE Building Energy Codes Program
- Energy Efficient Codes Coalition
- International Energy Conservation Code (IECC) and International Green Construction Code (IgCC)
- Lawrence Berkeley National Lab
- New York City Cool Roof Ordinance
- USGBC LEED standards



## Share your experience

### Such as:

- Help others by sharing your experience along the way.
- Partner with scientists, NGOs, or utility companies to spread the word or build your program

### Share your experience with us at:

- Cool Roof Toolkit
- Email Kurt Shickman at [kurt@globalcoolcities.org](mailto:kurt@globalcoolcities.org)