January 2012

A Practical Guide to Cool Roofs and Cool Pavements Implementation Guide

Ready to Act

Spreading the best practices and successes of existing initiatives

This guide is organized around two basic categories of activities to simplify the process of building and launching a successful cool roof and pavement effort: Foundational Activities and Implementation Activities.

Foundational Activities are important preparatory steps to building a solid base for launching programs, projects, and policies and should be conducted in advance of beginning Implementation Activities.

Implementation Activities offer best practices, case studies, and guidance for a variety of different cool roof and pavement program strategies. Implementation Activities are roughly broken into programs and policies. Implementation Activities can be undertaken in any order, or conducted in parallel since many are designed to be mutually supportive.

Implementation Guide

Foundational Activities

It is quite amazing—the payback on these kinds of [cool roof] investments really are very quick and make an enormous difference.

—New York Mayor Michael Bloomberg

Associated Press, "Bloomberg Hypes Energy Efficient Rooftop Painting." NYPost.com, September 24, 2009.

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 program including

- Identifying existing activities
- Assessing local potential
- Building local support and capacity

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.

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 studies
- 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?

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.

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

Identifying Existing Activities

Are cool surfaces a part of existing strategic plans, codes, laws, or incentives?

The first step in any effort to promote cool roofs and pavements in your city or region is to understand what has been done to date to support their adoption, and what plans are in place to further their adoption in the future. Start by determining if cool roofs and pavements are already a part of strategic plans or covered in existing ordinances or building and energy codes.

☞ *Ask: Is there a "visioning" process in place? If so, does it include a building efficiency or city cooling effort? If not, what is the process for adding to or amending the plans to include cool roofs and pavements?*

Strategic plans

The most likely place to find support for cool roofs and pavements is in your city or region's existing strategic plans (e.g., climate action plans, regional sustainability plans, etc.). First, determine whether or not there is a "visioning" process underway in your city or region (most cities and regions have these already developed or underway). These documents are often available on a city's official website. If such a process or document has been developed, check to see if it includes a building efficiency effort or a city cooling effort. These may be identified as "urban heat island mitigation" initiatives.

☞ *Ask: Are cool roofs included? What about cool pavements? Have they been considered? How are they included? What does the plan stipulate? If not, what is the process for getting them included?*

If cool surfaces are not already a part of your city or region's sustainability, climate action, or adaptation plans, or you feel that the plan's attention to cool surfaces could be strengthened, learn what the process is for adding to or amending these plans and begin to advocate for the inclusion of cool surfaces. It is important that any program set three, five, and ten year goals and include both pavements and roofs.

Strategic plans to research:

- ☐ Climate action plan
- ☐ Regional sustainability plan
- ☐ Adaptation plan
- ☐ Urban heat island mitigation initiatives

Codes and ordinances

The next place to look to understand what kind of support your city or region currently provides to cool roofs and pavements is in existing codes and laws. Check your city or region's building codes or pavement specifications to see if they include cool roofs or cool pavements. If they are included, what are the specifics?

Policies to research:

- ☐ City/region building codes
- ☐ City/region pavement specifications

Incentive plans including:

- ☐ Tax credits
- ☐ Utility rebates
- ☐ Loan programs

Learn more about building codes and incentives:

- Cool Roof Rating Council's website
- Database of State Incentives for Renewables & Efficiency

☞ *Ask: Does the code make cool surfaces mandatory? Are they included in a prescriptive code and therefore encouraged but not required? If the code sets whole building performance standards, do cool roofs and pavements count towards achieving the results?*

In some cases, cities will adopt a national standard. A list of popular national standards and their treatment of cool surfaces is on pages 72–73. Performing a local search is still important in places that have adopted national standards because there may be modifications made locally that strengthen or weaken the language on cool surfaces. One easy way to check codes and ordinances in your region is to review the Cool Roof Rating Council's list of cities/states with cool roof building codes.

Rebates and Incentives

Your city, region, and/or local utility may have incentives for cool roofs or cool pavements. Common incentives include tax credits, utility rebates, and dedicated loan programs. Note that most loan programs are designed to support energy efficiency upgrades in general, and include cool roofs in some instances. The Cool Roof Rating Council and the Database of State Incentives for Renewables & Efficiency (DSIRE) are both good resources for incentive programs, as well as codes and ordinances, for cool roofs and pavements.

For information on codes, ordinances, and incentives outside of the U.S., try the European Cool Roofs Council or local building technology research institutions.

How cool is my area already?

As a next step in understanding to what extent your city or region is "cool" already, identify the existing market penetration for cool surfaces in your region. A good place to start is by reviewing aerial or satellite imagery (such as those publicly available via Google Earth) to get an approximate sense of how light your roofs and pavements are already. Identify any high-profile buildings that have installed cool surfaces. University buildings, schools, government offices, and other landmark buildings can be used to build broader interest in cool surfaces. For example, the Department of Energy's Forrestal Building is being retrofitted with a cool roof, the University of California–Davis has installed cool roofs across its campus, Walmart has adopted a cool roof policy for its stores, and the City of Phoenix has installed a cool parking lot in its downtown area.

Case Study

Walmart: An Early Corporate Leader

Walmart has been an early corporate leader in deploying cool roofs on its stores. The retail giant began to install cool roofs on its facilities approximately a decade ago, and subsequently included cool roofing in their prototype store design. Now, approximately 75 percent of its nearly 4300 stores have white roofs. Internal studies found that, in most locations, having a reflective roof was a cost-effective investment that helped cut the energy budgets of individual stores.

The Walmart and Sam's Club in Chino, CA, are both equipped with white roofs and solar panels to help Walmart reach its goal of being supplied by 100 percent renewable energy. Photo: Walmart Stores

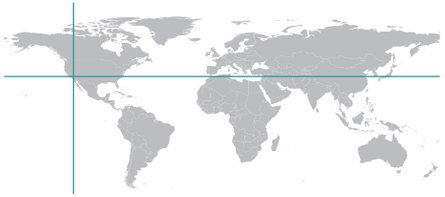
- Walmart sustainability website

Case Study

Chula Vista, California: A Cool Roof Initiative within a Climate Adaptation Plan

City of Chula Vista

Chula Vista, California, U.S.A.
Mayor: Cheryl Cox
Population: 243,916
Coordinates: 32°37'N, 117°2'W



Chula Vista, California. Photo: Port of San Diego

Chula Vista residents. Photo: City of Chula Vista

Background

In 2000, Chula Vista adopted a Carbon Dioxide (CO_2) Reduction Plan, which outlined steps for the City to reduce energy and fuel use as a means of achieving its commitment of reducing its greenhouse gas (GHG) emissions 20 percent below 1990 levels. The City's climate protection programs and policies have been a great success, helping Chula Vista reduce GHG emissions from municipal operations by 47 percent and community per capita emissions by 27 percent compared to 1990 levels. As a result, the City has been recognized for its climate-related accomplishments by multiple external organizations including the U.S. Environmental Protection Agency, ICLEI – Local Governments for Sustainability, California Sustainability Alliance, and the Sierra Club.

To complement these climate mitigation efforts, the Chula Vista City Council directed city staff in October 2009 to reconvene a Climate Change Working Group (CCWG)—comprising of residents, businesses, and community representatives—to develop a list of recommended strategies to reduce Chula Vista's vulnerability to expected local climate change impacts (i.e., a climate adaptation plan). Expected impacts include hotter and drier weather, diminished imported water supplies, more poor air quality/heat wave days, and increased rates of sea level rise. Stakeholders participating in the CCWG included representatives from development companies, business associations, energy and water utilities, environmental organizations, and education institutions.

The group held 11 public-noticed meetings between December 2009 and August 2010 to review potential impacts and identify over 180 opportunities to reduce these risks. In addition, the CCWG held two public workshops on climate adaptation planning to solicit additional feedback. The CCWG was further supported by regional experts, climate scientists, and staff from multiple municipal departments.

In October 2010, the Climate Change Working Group presented their 11 recommended Climate Adaptation Strategies to the City Council to address climate change vulnerabilities and solutions related to energy and water supplies, public health, wildfires, biodiversity, coastal resources, and the local economy. As a result, City Council directed city staff to develop more detailed implementation plans for the 11 recommendations, which would outline implementation steps, timelines, and costs.

Highlight

The recognition that average annual temperatures in Chula Vista are expected to increase up to 2.5 degrees Celsius (4.5 degrees Fahrenheit) by 2050 with summer temperatures increasing even higher, and that these rising temperatures, in tandem with a growing population, would cause peak electricity demand to grow by over 70 percent, led the Climate Change Working Group to carefully consider adaptation strategies that would help reduce the urban heat island effect. Cool paving and cool roofs are both recommended strategies.

Cool pavements

The CCWG recommended that the City develop an ordinance incorporating cool pavements into all municipal projects (parking lots and streets) and new private parking lot projects over a specific size. The City has committed to the following actions:

Cool paving study and test area
The Public Works Department (Operations & Engineering) will perform a pilot project to evaluate multiple reflective or cool pavement strategies to help inform creation of new policies for municipal paving capital improvement projects and private parking lot projects.

Cool paving study results and standards options
Based on the study results, city staff will develop options for incorporating reflective pavement into all municipal projects and private parking lot projects over a specific size. The options will be presented to City Council for review and consideration.

Cool roofs

The CCWG recommended that the City require and provide incentives for new residential developments with air-conditioning systems to install ENERGY STAR cool roof technology. The City has committed to the following actions:

Municipal building code update
The Building Division will further evaluate cool roofing options and propose amendments to the City's Green Building Standards to require cool roofs on new residential developments with air conditioning. Chula Vista Municipal Code Chapter 15.12 adopts and amends the 2010 California Green Building Standards Code (CalGreen). Currently, cool roofing is a voluntary measure in CalGreen, and staff will be proposing to make these measures mandatory. Staff will also evaluate the cost and benefit of requiring cool roofs on new residential developments without AC systems. Even though city staff is not proposing amending the California Energy Code to require cool roofs, the California Energy Commission will have to approve any cool roof ordinance before it can take effect.

Shade trees

Planting shade trees, another effective cooling measure, is also one of the 11 recommended strategies included in Chula Vista's Climate Adaptation Plan.

All of the recommended Climate Adaptation Strategies include performance metrics and discrete timelines and budgets. The expected budget for the initial implementation of both the Cool Pavements and Cool Roofs programs is $144,000 and ongoing annual expenses are estimated at $8,500.

Note: All of the content included in this case study is pulled from Chula Vista's Climate Adaptation Strategies DRAFT Implementation Plans, February 2011.

Unless otherwise noted, all dollars refer to USD.

chulavistaca.gov/clean/conservation/Climate/documents/ClimateAdaptationStrategiesPlans_FINAL_000.pdf

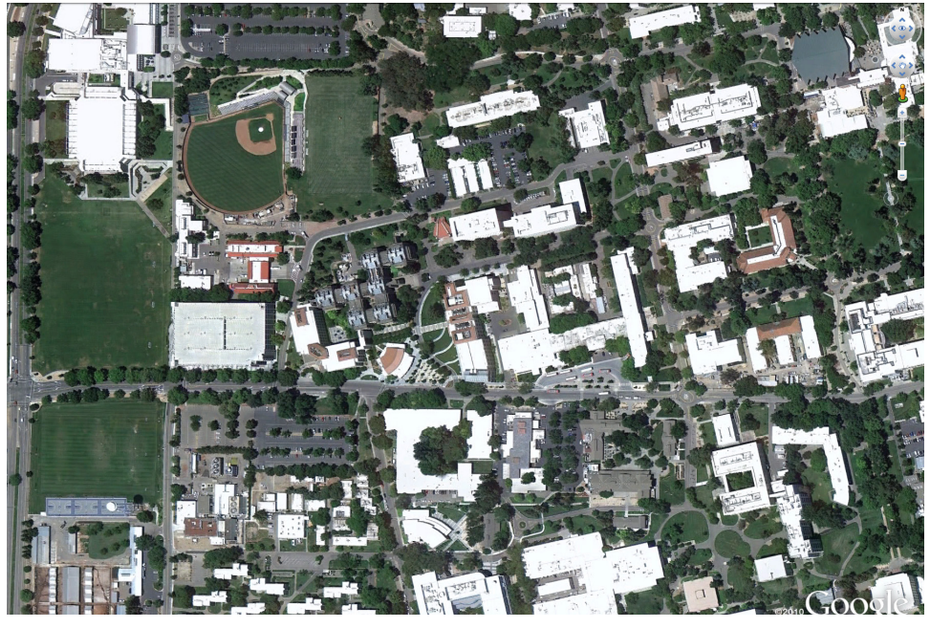
Assess Local Potential

Though it is clear that cool roofs and pavements are a net benefit almost everywhere, the exact benefits and costs of cool surfaces will depend on a variety of locally specific conditions. Measuring the many aspects of a cool initiative is critical to tracking progress, identifying successes and areas for improvement and raising awareness within the community and beyond. The first step is establishing a baseline of basic data and performance.

Building and pavement characteristics

Building type and age play a major role in determining the energy savings and indoor comfort benefits of cool roofs and pavements. Building data can be captured through tax records, permits, aerial imagery, and other sources. It can be very helpful to engage the local utility early in this process. There may also be existing files gathered for research projects, so checking with scientific institutions, universities, state energy agencies, or code bodies may be helpful. Anthropologists collect a great deal of useful building and behavioral data that could be helpful for your analysis. Local universities will often have access to the Human Relations Area Files that contain this information. Google Earth is a user-friendly and public resource for rough aerial imagery. Space agencies may have more advanced aerial visual or thermal imagery (e.g., NASA's ASTER satellite imagery) for locations around the world.

The data points in the boxes below will help you characterize your local built environment.



Google Earth view of UC Davis in Davis, California. Photo: Google Earth

Data points to collect: Roofs

- ☐ Urban fabric: Estimates of percentage of surface area covered by roofs, pavements, and other surfaces
- ☐ Total roof area: Commercial roof space (or percentage), residential roof space (or percentage), flat versus sloped roofs
- ☐ Estimated average building age (broad categories)
- ☐ Existing building codes for roof and roof insulation requirements
- ☐ Estimated roof life
- ☐ Market share of local roof types and materials

Data points to collect: Pavements

Research local/regional transportation agencies or gather from aerial imagery.

- ☐ Total amount of pavement area (often described as lane miles)
- ☐ Percentage of land area paved
- ☐ Pavement area by ownership/ responsible party (City roads, county roads, private roads, parking lots, and highways could be administered by city, county, state, national, or private stakeholders)
- ☐ Frequency of repair or repavement (Typically, parking lots are most frequently replaced, followed by city/ county roads, then highways.)
- ☐ Materials used by road type

Weather, climate, and air quality

Weather and climate data is equally as important as building data for an evaluation of the local benefits of cool surfaces. Weather data is often available from public sources or through local meteorologists or researchers. The NASA Atmospheric Science Data Center and the World Meteorological Organization offer access to key climate statistics for regions around the world. Air quality measurements can be obtained from local universities, health departments, environmental ministries, or other researchers. Having estimates for the characteristics in the list to the right is helpful.

Weather data points:

- ☐ Average annual solar insolation (the amount of solar radiation energy received on a given surface area in a given time, usually given in watts per meter squared (W/m^2)
- ☐ Average wind speed
- ☐ Maximum and minimum daily temperatures, degree days cooling and heating or average temperature by day for several years
- ☐ Air quality (pollutant types and frequency)
- ☐ Frequency of extreme heat events

Energy use and pricing

Utilities and electric grid operators have access to important data such as source energy mix, energy pricing, and usage statistics. These data sets can often be shared at an aggregated level. Both New York City and New Orleans created a helpful chart by combining energy use data with average daily temperatures to determine how much cooling costs rise per degree of maximum daily temperature. This kind of analysis creates a simple methodology for valuing incremental drops in temperature. (see New Orleans Hot Weather Energy Demand on page 14).

Local roofing market

The roofing industry will have the most locally specific market information and should be engaged early in the scoping process. Talk with large local contractors, distributors, and manufacturers to evaluate the market availability of various cool roofing and pavement products and to understand the cost differences (if any) between cool and uncool products.

☞ Ask: *Are major roofing players marketing cool products? Is there demand for these products and, if so, from what types of building owners? What questions are consumers asking about cool products? Have contractors required additional training to install cool surfaces? What benefits and challenges have consumers raised?*

Making the case for white roofs in Chula Vista.
Photo: City of Chula Vista

Making the case

An evaluation of the impacts to your city or region from cooler roofs and pavements will be very useful in helping build support and momentum for policies and programs. Start by reviewing detailed feasibility studies conducted by other cities and regions that helped inform their cool roof policy and code-making initiatives. While these won't be as accurate as a custom local study of your region, it is worthwhile to review existing analyses before undertaking a new one. Existing studies provide insights into good methodologies to include in your own study. In cases where a city/region has a similar built environment and climate to yours, the results can be a good starting point for your own analysis. Examples of existing studies and initiatives can be found at the Global Cool Cities Alliance website.

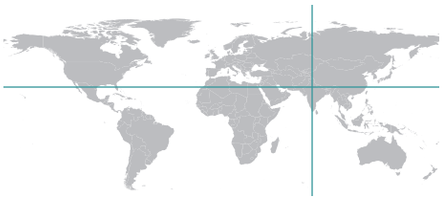
If no current study exists and your city or region is ready to engage in a customized analysis of the potential impacts of going cool, the first steps are to scope out the study, develop a request for proposals, and identify an individual researcher, or organizations that can take on the work. Local research facilities or consulting groups can be ideal partners for such a study. The study would use the data collected (see page 52 and 53) to evaluate the energy, health, and other benefits of a cooler city/region as well as offer some suggestions for a deployment strategy. The cities of Houston and Dallas both worked with the Houston Advanced Research Center to develop detailed analyses of the potential for various urban heat island mitigation technologies in their metro-regions. You can read about these efforts in the case study on page 69. Local universities could be a valuable source of analytical support and technical assistance. In some cases, graduate students can provide free or low-cost support.

Case Study

Delhi, India: Cool Roofs on High-Profile Buildings

Delhi Department of Environment

Delhi, India
Chief Minister: Sheila Dikshit
Population: 19.8 million
Coordinates: 28°36'N, 77°13'E



A new program in Delhi offers a good illustration of the best practice of using government buildings as test sites, the benefits of having a strong local champion, and how to maximize the value of pilot projects.

In January 2011, the Chief Minister of the City of Delhi announced a pilot project to install cool roofs on some government buildings in the city. Delhi will start with high profile sites like the Delhi Secretariat (shown below) as well as all government schools and some hospitals. A number of different cool roof materials will be used, including elastomeric coatings, lime coatings and tiles. Technical experts will measure the demonstrations to generate locally relevant cool roof performance data. The choice of schools and hospitals has the added advantage of using sites that are accessible to the public. Visibility of these demonstration projects to the public will help raise awareness of the energy saving and thermal comfort benefits of cool roofs.

The pilot comes amid a severe power shortage in the region. The highest levels of the Delhi government have embraced cool roofs as an important step to take to save energy and reduce peak demand. The involvement of city leaders in championing the project helps to maintain the momentum of the initiative.

The goal of the program is to grow in phases. Ultimately, the Chief Minister envisions a longer-term pilot program that would include a neighborhood sized sample area to demonstrate the citywide benefits of cool materials. Such an approach allows for growth in the size of the project (and in the breadth of the information gathered) by leveraging earlier work.

Delhi Secretariat building. Photo: Laurie Jones

Buildings in Old Delhi. Photo: gwgs

Build Local Support and Capacity

As beneficial as cool surfaces are, there will always be competition for local resources, time, and effort amongst worthy policy objectives. Building local awareness of and support for cool surfaces is a critical task to start early. There are a wide variety of important stakeholders that should be a part of the planning process. One way to bring these disparate groups together and to build momentum and catalyze action for cool roofs and cool surfaces is to develop a steering or leadership committee of key agencies and private stakeholders to oversee implementation and provide a point of contact for decision-makers.

Best practices for official buy-in:

- ☐ Identify and approach other key entities that can organize across agencies (e.g., regional managers, finance agencies, school districts, planning offices), and other regional organizations like air and water quality agencies which may become important partners.
- ☐ Strive to inform and include representatives from local departments of energy, environment, transportation, public works, housing, and health.
- ☐ Regional planning agencies may already include a robust stakeholder mix and should be approached early in the process.
- ☐ Departments with a large portfolio of buildings, such as school districts, universities, and corporate campuses should be brought into the early stages of the process.

Local officials

A city or region-wide transition to cool materials will be accelerated in those cities or regions where the leadership prioritizes and actively promotes the concept of going cool. A focused effort to garner the buy-in and support of top officials and key stakeholders is an important component to any cool surfaces campaign. Support from top officials (governor or mayor, if possible) will help secure buy-in across relevant governmental departments, and help raise awareness and visibility for cool roofs as an effective mitigation and adaptation strategy.

Building owners

Ensuring widespread installation of cool roofs and cool pavements requires that the people responsible for selecting roof and pavement materials are well informed about cool surface options, benefits, and costs. A high level of education is especially important for those who make decisions about surfaces that are repaved or reroofed frequently. An information campaign targeted at key decision-makers is an important element of developing support and momentum for cool surfaces. Key decision-makers include policymakers, but also building owners and industry professionals such as local contractors and architects. Converting major commercial building owners into cool roof champions can be an effective way to quickly catalyze the transition to cool materials because they often own both a significant amount of roof area and some of the most high profile buildings. Furthermore, they are often politically influential and can typically move more quickly than governments. To engage local building owners, start by creating an inventory of major commercial building and/or parking lot owners (e.g., industrial/manufacturing complexes, large retailers, major residential developers) and identify high profile buildings that might be a good fit for cool roofs (e.g., stadiums, conference centers, large hotels, university campuses). Help building owners run the modeling necessary to determine whether or not cool roofs will be a profitable investment for them. These tools are publicly available online. For example, The Roof Savings Calculator is a good starting place: roofcalc.com.

A white roof on the Phoenix Civic Center, a focal point of activity in downtown Phoenix, AZ. Photo: United Coatings

Other champions

It is important that early on in the development of your cool city campaign you identify existing or potential champions who will be able to drive cool roofs implementation to the next level in your city or region. These champions may include manufacturers, building owners, roofing contractors, and/or utility program officers or executives. Share this guide with them! If no strong existing or potential champions exist, consider becoming a champion yourself. To do this, use this guide to become a cool roof and pavement expert.

General public

Eventually, everyone in your city or region will have a role to play in transitioning to cool surfaces. By the time your campaign requires public outreach, it should have specific programs developed that members of the public can opt into (e.g., tax incentives, utility rebates, corporate sponsorship opportunities).

Attracting funding

One of the major challenges of any new initiative is finding ample funding. There are a variety of funding options and combinations to consider (see checklists on page 59).

When building a local stakeholder group, consider what kind of funding each partner has access to and expertise in securing.

Landscape architect Ruth Fox discusses the green roof at Water Tower Place with residents in Cedar Rapids, Iowa.
Photo: 350.org

Develop local training and education programs
Demonstration projects, code changes, new incentives, and other policies are opportunities to raise awareness about cool surfaces. Each can be a useful channel around which to build cool roof training. Target initial training sessions with local building trades, architects/designers, and other construction stakeholders. The American Institute of Architects already runs a periodic training for architects on cool roofs and coatings, and may be a good distribution partner. In addition, local contractor, labor, and roofing consultant networks can identify existing curriculum or help design new training materials. Training materials should include a discussion of the interaction between roof insulation and cooler surfaces, as well as other building system impacts. Training methods include web-based information, informational videos, and in-person workshops. These training programs can be developed in coordination with local building and roofing organizations to ensure that information is consistent.

California's cool roof requirements have included a wide range of outreach and education activities including online training and training videos for code enforcement staff and building trades. You can view some of their training documents here: energy.ca.gov/title24/

Some cities have developed volunteer programs to coat roofs. Volunteers supplement the work of contractors and typically work on different buildings than those serviced by most contractors (e.g., public buildings, lower income dwellings, buildings owned by non-profit organizations). For example, New York City has coated almost 2 million square feet of rooftop during its two-year old cool roof volunteer program. The city pays for about 50 percent of the cost of materials and organizes the volunteers. Such programs help raise public awareness of cool surfaces, complement the work of the private sector, and deliver a steady stream of good press about cool surfaces.

Identify technical resources locally and globally
Building relationships with local and international experts will be extremely valuable as you develop a cool surfaces program. These experts—researchers, academics, manufacturers, consultants, and more—have a wealth of knowledge and experience. Identify building or energy research centers in your area. These groups often have cool roof and pavement expertise and a deep understanding of the local market.

The University of California Energy Institute maintains a comprehensive list of regional energy institutes. You can search their list here: ucei.berkeley.edu/ucei/nrgorgs.html

The Global Cool Cities Alliance, Lawrence Berkeley National Laboratory's Heat Island Group, Oak Ridge National Laboratory's Building Envelopes Group, and Environmental Protection Agency Heat Island Group should all be able to assist you directly or help identify

Scientists and educators from the Smithsonian Conservation Biology Institute and George Mason University attend a groundbreaking ceremony for a new green design conserbation complex in Virginia
Photo: Smithsonian's National Zoo

resources in your area. These officials are often involved with research and experts in the cool roof and pavement space. Another avenue is to connect with your country's energy or environmental ministry.

Join or leverage existing memberships in city/regional organizations
Groups like GCCA, R20, ICLEI, National Governor's Association, C40, and others have networks to connect you to program managers and decision-makers in other regions. Attend workshops, meetings, and conferences.

Funding ideas:

- ☐ Secure funding from local, state, or federal government grants. Apply for grants from national agencies.
- ☐ Identify funding opportunities from multilateral sources.
- ☐ Seek out philanthropic support.
- ☐ Require contributions from building owners.
- ☐ Partner with corporations.

In-kind support ideas:
Cities can also seek in-kind support that will offset an expense they would normally incur running programs. For example

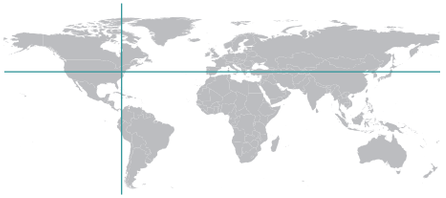
- ☐ Volunteer programs
- ☐ Bulk material discounts
- ☐ Technical support and training
- ☐ Program marketing assistance

Case Study

NYC °CoolRoofs: A Successful Volunteer Initiative

NYC °CoolRoofs

New York City, New York, U.S.A.
Mayor: Michael Bloomberg
Population: 21.3 million
Coordinates: 40°43'N, 74°00'W



Background

In 2007, New York City's Department of Design and Construction conducted a study on cool roofs and green roofs to better understand the applicability, technicalities, costs, and benefits of both roofing strategies. (Download the study here.) One driver of this study was the finding that New York City was 13 to 14 degrees Celsius (5.4 to 7.2 degrees Fahrenheit) hotter than nearby rural areas.[1] In doing this analysis, department staff were struck by the cost effectiveness of cool roofs; they are at least an order of magnitude less expensive to install than green roofs.

The City's Office of Long Term Planning and Sustainability also conducted an analysis of the benefits of transitioning the city's roof stock to cool roofs, from both a building owner and city-wide perspective. Their analysis indicated that the city could achieve one degree of cooling if cool roofs were installed across the city and further found that for each degree (Fahrenheit) of temperature rise, the city consumes an average of 3,300 megawatt hours more energy on days when cooling is required. Since cooling is required on approximately 150 days annually, the annual energy savings for each degree of temperature reduction (Fahrenheit) would be roughly 495 million kilowatt hours. At an average cost of 16.5 cents per kilowatt hour, the annual cost savings resulting from one degree decrease in NYC's temperature during warm months would be roughly $82 million.[2]

In 2009, Mayor Bloomberg and former Vice President Al Gore helped the Department of Buildings and Sustainability and NYC Service kick off a pilot program for cool roofs. They selected a "hot pocket" (an area that had been subject to blackouts and was a peak load demand area) in Queens for the pilot. Because of the potential of the program to reduce electricity demand, ConEdison became the lead sponsor of the pilot. During the three week pilot, more than 100,000 square feet (just over 9,000 square meters) of cool roofs were installed through the use of volunteer labor and donated materials. In 2010, the City launched a dedicated cool roof program, which passed its initial annual goal of 1 million square feet (just over 90,000 square meters) of cool roofs installed by October 2010.

Volunteers in Queens, New York. Photo: Community Environmental Center

Former U.S. Vice President Al Gore and New York Mayor Michael Bloomberg kick off the pilot program. Photo: Edward Reed, NYC.gov

Launch of the NYC °CoolRoofs program at LaGuardia Community College in Queens, New York. Photo: Community Environmental Center

Highlight

New York City's cool roofs program has done an exemplary job of securing the participation of volunteers to help speed the City's transition to cool roofs. The NYC °CoolRoofs program is run as a joint effort between NYC Department of Buildings and NYC Service, the agency responsible for coordinating city-wide volunteer efforts. °CoolRoofs is NYC Service's largest environmental initiative. The program targets corporate sponsors who provide volunteers and funding to cover the cost of materials. The City identifies buildings and coordinates the logistics of the "coating days." The City partners with two local non-profit organizations, Green City Force and Community Environmental Center. These non-profits assume liability for the events, coordinate inspections, which ensure volunteer safety and the appropriateness of cool roofs for the individual buildings, and provide staffing for the "coating days." Green City Force provides workforce development to underserved youth (ages 18 to 24). In 2010, its 34 Corp Members coated 500,000 square feet of roofs. Without the support of these non-profits, the City would not be able to run the program.

Performance

In 2010, NYC °CoolRoofs coated 1,168,369 square feet (108,545 square meters) of rooftops across 135 buildings. Sixteen-hundred volunteers participated in these coating efforts.[3] Seventeen companies participated and almost all of them have repeated the program in 2011. The program has continued to expand in 2011 and the City recently passed two million square feet (18,500 million square meters) cooled.

One million square feet (just over 90,000 square meters) of cool roofs should reduce New York City's carbon emissions by 27 tonnes or 500,000 pounds. This reduction is equal to removing 50 cars from the road or having 300 New Yorkers not drive for an entire year.[4]

1. NYC Cool and Green Roof Manual

2. Reducing New York City's Urban Heat Island Effect, Laurie Kerr, Office of Sustainable Design, 2004.

3. NYC Cool Roofs Annual Review, 2010.

4. NYC Cool Roofs Annual Review, 2010.

Unless otherwise noted, all dollar amounts are in USD.

Ready to Act

Use these tools and best practices to start or grow your own cool surfaces program.

Implementation Activities offer best practices, case studies, and guidance for a variety of different cool roof and pavement program strategies. Implementation Activities are roughly broken into Programs and Policies. Implementation Activities can be undertaken in any order, or conducted in parallel since many are designed to be mutually supportive.

Implementation Guide

Implementation Activities

Implementation Activities

If you have made your way through the activities in Foundational Activities, you are now in a strong position to undertake a wide variety of implementation initiatives. This guide lays out a number of options that have worked well in cities or regions around the world. Implementation Activities is broken into two basic approaches: policies and programs. There is no magic starting place, but the most successful cases 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.

The items in the overview checklist on this page can be undertaken in any order, or conducted in parallel since many are designed to be mutually supportive.

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 (page 75), Chula Vista (page 50), New York City (page 60), Walmart (page 49), Delhi (page 55).
- 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 officials and utilities to develop incentives.
- ☐ Include cool surface requirements in procurement specifications.

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

Design and launch programs

Programs are a tangible way to demonstrate the value of cool roofs and surfaces. Cities often pair programs with incentives to help drive attention and interest. With any program, it is a good idea to engage a variety of government agencies and to identify partners who can run the day-to-day operations. Appropriate stakeholders will differ by program type but could include weatherization groups, green worker training organizations, industry partners, or local research institutions.

Training for contractors:

A more efficient way to reach contractors—beyond developing and offering training programs directly—may be through organizations that already provide training to them and to other building professionals, for example:

- ☐ Architecture organizations, such as the American Institute of Architects, that offer training programs for practitioners (e.g., contractors, designers, architects).
- ☐ Manufacturers of cool coatings and materials that offer training resources. (As noted earlier, work through distributors to identify manufacturers serving your area and approach them directly.)
- ☐ Many contractors or their trade associations have well-designed worker training programs. Coordinate with them to ensure a strong flow of new local labor to meet new roofing project demand.

Awareness raising

Several activities in Foundational Activities help build communication channels to raise public awareness of cool roofs. Use those channels, supplemented by broader communication efforts (e.g., advertisements, public statements, flyers) to describe the reasons for pursuing local cool surface efforts, provide details of new programs, and explain how to participate.

Education and training

Good education and training programs are critical to the success of any policy or initiative. Training contractors allows them to respond to new codes or ordinances and leverages their marketing activities to spread the word about new programs or policies. There are a number of different ways—beyond developing and offering training programs directly—to provide training for contractors (see checklist to the left).

Demonstration projects

Demonstrations of cool roof and pavement technology can provide important local performance data and, if in a high-profile location, can help to raise interest and awareness. Since one of the primary goals of demonstration projects is to refine local simulation results with real data, it is a good idea to partner with a research institution to fully monitor and measure the impact of cool installations. It is best to bring these partners into the design stages of the project to ensure that a good baseline of data is available before the project begins and to minimize other changes to the pilot site so that comparisons are useful and relevant.

The first step in developing a demonstration project is to identify neighborhoods or regions where the impact of cool surfaces would be the greatest. A good demonstration project site can be difficult to quickly identify so start the process as early as possible. Consult with community leaders, researchers, and other important stakeholders at this stage and build a process to help them share their thoughts and opinions (see checklist below).

Engage the community to help garner resources for the effort and build momentum. Partner with local NGOs, businesses, and other sustainability efforts to empower individual action and generate donated resources (volunteers, materials, etc). Identifying local iconic, high-profile buildings to incorporate into the pilot will help raise awareness.

Identify a building, location, neighborhood, or region for a demonstration project:

A number of factors will drive the selection process but some combination of the following characteristics is optimal:

- Enthusiasm on the part of the neighborhood and willingness of the property owner to test new materials or to be a proof of concept for a city new to cool surfaces
- A site sufficiently large and contiguous so as to allow the study of both the building and neighborhood effects of cool roofs and pavements (Ideally, the pilot site would be a couple of square kilometers.)
- A good mix of building types and uses
- A high percentage of non air-conditioned buildings (and, thus, residents who are more exposed during heat waves)
- Areas with particularly poor air quality
- A site with only a small number of building owners so as to speed the approval process and offer the ability to control occupant behavior during the pilot (College campuses and military bases are examples of sites with many buildings but only one “owner”.)
- An area with a particularly hot microclimate or high seasonal energy use

Pilot projects can be expensive. Be creative in developing financial support and develop partners who can access a wide variety of funding sources including grants from government agencies, corporate contributions, in-kind support, philanthropic giving, or multilateral development bank funding.

A number of cool city projects demonstrate not only good research practice but also an impressive mix of partners.

Volunteer programs

Engaging citizens and local corporations in volunteer programs that apply cool coatings has proven effective in places like New York City. As with most efforts, finding good partners early is a key step. New York City, for example, partnered with Google and Consolidated Edison, the local utility. If you plan to use volunteers to help coat roofs, it is important to identify a portfolio of buildings that would be appropriate for unskilled volunteers to work on. Typically, these should be lower buildings with low-sloped (i.e., basically flat) roofs, easy roof access, and robust safety equipment (e.g., guardrails etc.). A good place to start is with local schools, public buildings and lower-income multi-unit housing. Engineers should inspect the roofs of candidate buildings

Mayor Bloomberg of New York City announces the NYC ºCoolRoofs Program. Community Environmental Center president Richard Cherry is at the left, and Kevin Burke, the president of Con Edison, is at the right. Source: Community Environmental Center

to ensure they are sound and ready for a cool coating. Coating manufacturers may be able to help train volunteers on the appropriate way to apply the coating. Pairing volunteer groups with buildings can be a challenge as volunteer groups will have specific needs, primarily location and an appropriately sized roof for their group. Successful volunteer programs are fun for the participants. Providing food and interesting speakers is one way to ensure that participants have an enjoyable experience. It will be important to publicize completed projects to maintain a steady flow of good press to keep the public engaged. Running such a volunteer program is a significant amount of work. Coordinating multiple roof coating events per week, or per day, will require at least one dedicated staff member. Finding the staff resources can be difficult. If your city or region has a service department, they may be able to take on the program. Alternatively, a service oriented non-profit organization may be able to take on the coordinating role. Insurance is another requirement for these kinds of programs that city governments will typically not be able to cover. Insurance may need to be provided by a non-profit partner.

Contests

Another way to raise awareness of cool roofs and pavements while spurring deployment is to create public competitions to earn cool roofs or pavements. For example, the Philadelphia, Pennsylvania Coolest Block Contest was a collaboration between the mayor's Office of Sustainability, a non-profit implementing agent (Energy Coordinating Agency), and a cool material manufacturer (The Dow Chemical Company). Residential blocks organized by "block captain" applied for the prize of having free cool roofs installed. A short list of eligible blocks was determined by which had the highest sign-up rate of block residents. Renters were required to get sign-off from landlords to participate. A selection committee then evaluated essays each block submitted with their applications and chose a winner. Mayor Michael Nutter announced the winning block during a rooftop signing ceremony for a city ordinance requiring cool roofs on new low-slope roofs. The cool roof installations were performed by the Energy Coordinating Agency with materials donated by the Dow Chemical Company. The kick-off featured a block party that was free to residents, and provided a high-profile and press-worthy opportunity for local politicians to reaffirm their commitment to sustainable communities.

Measuring success

Once the pilot project has been successfully implemented, it is important that the research partners reengage and assess the performance of the cool roof and/or pavement installation. Technical monitoring ideally would include: electricity savings (for air-conditioned buildings), indoor air temperature reductions (for non air-conditioned buildings), above pavement temperatures, and ambient air temperature and quality. As cool roof and pavement pilots crop up around the world, it will be important that researchers use standard monitoring protocols so that data can be easily aggregated.

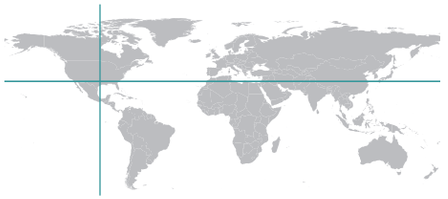
Philadelphia, the Energy Coordinating Agency, and the Dow Chemical Company ran a contest for the "coolest" block in the city. Photo: RetroFIT Philly program. © Nigel Maynard

Case Study

Dallas and Houston, Texas: Urban Heat Island Assessment in Partnership with a Third Party Research Organization

- Houston Advanced Research Center, Houston Urban Heat Island Effect
- Dallas Urban Heat Island Study

Dallas and Houston, Texas, U.S.A.
Mayors: Mike Rawlings (Dallas) and Annise Parker (Houston)
Populations: 1.2 million (Dallas), and 2.1 million (Houston)
Coordinates: 32°46'N, 96°48'W (Dallas) and 25°45'N, 95°22'W (Houston)

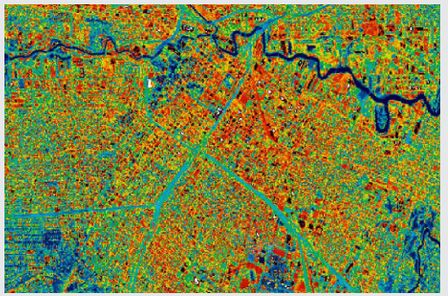


Some cities have undertaken comprehensive evaluation of the urban heat island effect impact on their communities and identified strategies to mitigate it. Working with initial funding from the U.S. Environmental Protection Agency and foundation support, a regional research organization called Houston Advanced Research Center (HARC) worked in partnership with city officials to undertake an analysis of the urban heat island effect in Houston and Dallas, Texas. HARC set out to determine where the hotspots were in each city and how hot they were, and to identify strategies for cooling them down. The reports also provided background on the urban heat island effect to help educate policymakers.

The HARC team began by evaluating available thermal and aerial imagery of both cities to help characterize their urban fabric. For Dallas, a local community college agreed to process imagery from NASA's ASTER satellite imagery. The college used the analysis as a learning tool for their students and performed the work free of charge. In Houston, analysis from NASA and a DOE national lab was available. This type of analysis was integral to shaping heat island mitigation strategies. For example, the thermal analysis of Dallas revealed that industrial warehouse areas were the hottest, not the downtown zone as had been expected.

In addition to a characterization of the urban heat island, HARC's report also included three strategies for cooling the city: cool roofs, cool pavements, and shade trees. HARC provided a basic description of each technology and a cost/benefit analysis and suggested policy interventions to help speed implementation.

HARC presented the findings to both cities and, in Houston, facilitated a series of working groups to develop the actual implementation plan. The working groups included representatives of the roofing industry, local government (including the policy, public works, stormwater management, and parks and recreation departments), the local university, environmental groups, business organizations, and developers. This process took about a year in Dallas and about two and a half years in Houston, where the scope of the exercise was broader. Under the leadership of Mayor Bill White, Houston subsequently adopted cool roof provisions as part of its building code, and has continued to pursue its million tree plus campaign.



Thermal image of central Houston. Photo: NASA Marshall Space Center, September 1999

Implement policy

There are two basic policy interventions: regulations and incentives. Regulations take the form of building codes, energy codes, ordinances, and/or pavement specifications. Incentives come in a variety of financial and non-financial forms from rebates and tax breaks to priority permitting and relaxed code standards in other areas. Whether you are considering regulations, incentives, or both, policies are most successful when targeted at building owners' decision points; in this case, reroofing, new or replacement roof installation, or repaving.

Building codes, energy codes and pavement specifications

One of the highest impact ways to support the rapid implementation of cool roofs and cool pavements is to include them in your region or city's building codes or pavement specifications. That said, making changes to the codes can be a long and time-consuming process.

Researching the existing status of cool roofs and pavements in local building and energy codes and ordinances is an important first step, and is described in the Foundational Activities section. A good second step is to identify model language to use as a basis for local cool codes (see below).

Once you have identified good code language and modified it (if necessary) to meet local needs, the work of getting the language officially adopted begins. As demonstrated by the California case, building a coalition of stakeholders that can help lead and participate in this campaign is critical. Changing building codes requires considerable time, effort, and support from community leaders. In addition, it is crucial to have the support of stakeholders in the building trades and the business community. Such changes should only be considered after there is sufficient understanding and support among community leaders and stakeholders.

Once codes are enacted, they must be monitored and enforced. If cool roofs and pavements are already included in your city or region's codes, but the codes are not getting enforced, focus on working with enforcement officials to improve their oversight. One good way to start is to use publicly available aerial imagery like Google Earth to identify whether buildings that recently received permits to install new or replacement roofs are in fact in compliance. While this visual test is not sufficient for code enforcement purposes, it will help prioritize the field of buildings to inspect and give building owners and contractors the sense that their activities will be reviewed. That said, Google Earth and public imagery tools are a good first step but may include older images. Enforcement should be based on new images or visual inspections.

Look up codes and specifications:

Cities and regions have used a number of sources to inform changes to their codes and specifications. These include the following:

- New York City Cool Roof Ordinance
- ASHRAE 90.1, 90.2, 189 standards
- International Energy Conservation Code (IECC)
- International Green Construction Code (IgCC)
- Energy Efficient Codes Coalition
- USGBC LEED standards

See the table on the following page for more codes and specifications.

Model language for cool codes:

- California offers a great case study not only because of the robust cool roof standards that were enacted, but also because of the process used and the diversity of the climates covered by the new code. In 2005, California prescribed white surfaces for low-sloped commercial roofs as part of its Title 24 energy efficiency codes. In 2008, the state prescribed cool colored surfaces on steep roofed residential buildings in its five hottest climate zones. (California recognizes 16 climate zones in its energy and building codes.) Cool roof standards were the result of utility Pacific Gas and Electric working with technical experts at the Lawrence Berkeley National Laboratory to make a strong quantitative case for cool roofs across nearly all of California's diverse climate zones.
- New York City built on California's approach and developed an equally stringent code that reflected its many roof types and uses. Their code went into effect in January 2012.

Case Study

India's Cool Roof Building Codes

Cool roofs and pavements feature in a number of India's building codes and standards. In 2007, India's Bureau of Energy Efficiency incorporated cool roofs into its Energy Conservation Building Code (ECBC-2007). Projects qualify either under a prescriptive approach (where materials and technologies are specified) or a whole-building performance approach. Buildings attempting to qualify via the prescriptive method must have roofs with a reflectivity of at least 0.70 as determined by widely accepted testing standards (ASTM E903-96). For a building taking the performance approach, designers may include highly reflective roof assumptions in the modeling required to qualify. The ECBC is currently voluntary but will become mandatory in 2012 for commercial buildings in eight states, including Delhi and Maharashtra.

- India Bureau of Energy Efficiency

The Bank of India in Mumbai, Maharashtra. India's Conservation Building Code of 2007 is currently voluntary, but will become mandatory for commercial buildings in eight states, including Maharashtra, in 2012. It requires an initial SR of greater than 0.7 and initial TE of greater than 0.75. Photo: United Coatings

Building Codes and Standards

U.S. Code	Description	Cool Roof Requirement
ASHRAE 90.1	U.S. national, model code for commercial and high-rise residential buildings	Allows reduced roof insulation if a cool roof of SR ›0.55 and TE ›0.75, or SRI ›64 is used. This allowance is permitted in climate zones 1–3 only. Several exclusions.
ASHRAE 90.2	U.S. national, model code for low-rise residential buildings	Allows reduced roof insulation if a cool roof of SR ›0.65 and TE ›0.75, or SRI ›75 is used. This allowance is permitted in climate zones 1–3.
ASHRAE 189.1	Voluntary, "advanced," national model code for commercial and high-rise residential buildings.	Requires that 75% of the roof surface of a building and parking lot covering be a cool roof. The Standard defines a cool roof as having an SRI of 78 for low-sloped and 29 for steep-sloped roofs, or as a roof material that complies with ENERGY STAR.
California Title 24	Residential and non-residential energy efficiency standards. Cool roof requirements vary by region.	Low-sloped roofs: aged SR ›0.55 and TE ›0.75, or SRI ›64 Steep-sloped, weight ‹5 lbs/ft²: aged SR ›0.20 and TE ›0.75, or SRI ›16 Steep-sloped, weight ›5 lbs/ft²: aged SR ›0.15 and TE ›0.75, or SRI ›10
Chicago Energy Conservation Code		Low-sloped roofs: initial SR ›0.65, aged SR ›0.50, TE ›0.90 Medium-sloped roofs: initial and aged SR ›0.15, TE ›0.90
Florida Building Code	The 2007 Code includes a credit for cool roofs in their performance-based requirements for residential buildings.	SR ›0.7 TE ›0.75
Hawaii	Prescriptive requirement for low-slope residential roofs that includes cool roofs as one of four ways to meet the standard.	SR ›0.7 TE ›0.75
IECC Chapter 5 (proposed 2012)	U.S. national, model code for commercial and high-rise residential buildings	Required for low-sloped roofs above air-conditioned space only in climate zones 1–3. Four ways to qualify: • aged SR ›0.55, aged TE ›0.75 • initial SR ›0.7, initial TE ›0.75 • aged SRI ›64 • initial SRI ›82 Exceptions are roof area that is shaded, covered by equipment, vegetated, or ballasted.
LEED Green Building Rating System	Leading voluntary green building standard in the U.S.	Cool roofs (for flat roofs with an SRI ›78 and sloped roofs with an SRI ›29) = 1 point Cool materials used on other impermeable surfaces = 1 point
New York City Local Law 21	Cool roof requirements for low-sloped roofs. Includes modifications for a variety of roof types and uses.	Initial SR ›0.7 and TE ›0.75, or SRI ›78
U.S. EPA ENERGY STAR	ENERGY STAR is EPA's energy efficiency product label. It includes labels for roofing products.	Low-sloped roofs: initial SR ›0.65, aged SR ›0.50 Steep-sloped roofs: initial SR ›0.25, aged SR ›0.15
Washington D.C.	Building code for commercial and residential buildings.	Low-sloped roofs: SRI ›78. Green roofs and other exceptions apply.

Source: CRRC and Akbari et. al. "Evolution of Cool Roof Standards in the U.S.", 2008

A brief note on the types of codes

There are a variety of ways that cool roofs and pavements may be incorporated into building and energy codes. Below are descriptions of some common examples:

- **Mandatory measures** All buildings must comply with mandatory measures regardless of compliance path.
- **Prescriptive compliance** Compliance through prescriptive packages that vary with climate zones—no trade-offs allowed.
- **Performance compliance** Use an approved compliance software to demonstrate compliance for the entire building—allows trade-offs.
- **Compliance options** Measures that are not required prescriptively but can result in a compliance credit if installed, such as high Energy Efficiency Ratio (EER) air conditioning and buried ducts.
- **Cool surfaces procurement specifications** Before codes or ordinances are adopted broadly, governments can lead by example by incorporating cool surfaces into their own procurement policies and lease requirements. Governments are often major building owners or tenants, so cooler procurement may help spur market development. It can also build a database of energy savings and other benefits that could be used by local authorities to justify new ordinances and codes for cool surfaces. For example, U.S. Secretary of Energy Dr. Steven Chu directed all Department of Energy offices requiring a new or replacement roof to install cool roofs if they are cost effective over its lifetime.

Incentives

Financial Incentives may help sway building owners towards cool roofs or encourage them to install roofs and pavements that exceed performance required by code. Financial incentives typically take the form of rebates, tax incentives, or cooperative/volume purchasing. To develop such programs, start by conducting a careful analysis of price premiums and savings potential, then work with the city, region, or utility to establish criteria for eligible buildings and eligible reroofing or repaving materials and create the funding mechanism. One rule of thumb is to target incentive levels so they are 50 percent of the incremental cost of choosing cooler options. Incentives will be particularly important in promoting cool pavements because they do not generate direct energy savings for their owners but are important for mitigating the urban heat island effect. While some cool pavements generate positive return on investment by increasing durability or reducing lighting costs, rebates will likely be needed to make the economic case for most owners. Incentives will also be important for steep-sloped roofs because the cost premium for cool-colored roofing materials is typically higher than for flat roofs, and the air-conditioning savings are lower because the solar reflectance is lower, thus the pay back is longer. This cost premium means that it will take longer for building codes to require cool roofs for steep-sloped roofs. Therefore, incentives will be the primary tool for catalyzing adoption.

Rebates can be established by the local utility or government and are typically awarded on a per square meter or per square foot basis. In California, rebates were used before codes were enacted to encourage the installation of cool roofs. Once codes were enacted, the qualifications for the rebates were increased to encourage building owners to install roofs above code requirements. Toronto's Eco-Roof Incentive Program, for example, offers a $2 per square meter incentive for a coating over an existing roof or a $5 per square meter for a new roof membrane to a total possible incentive of US $50,000. Cool roofs must be installed on an existing building in order to be eligible for funding. The program is funded in part through cash payments made by building owners who wish to opt out of Toronto's green roof requirements.

Tax Incentives can be structured similarly to rebates, but provide small tax advantages instead of direct payments. Local taxing jurisdictions should be a part of the development process and could be reimbursed for the incentives offered. There are a number of ways to organize tax programs. Property tax incentives could be offered for new or replaced roofs or resurfaced parking lots. Sales taxes could be waived on the purchase of cool roofing and pavement materials. Water taxes could be reduced if permeable pavements or roof water management systems are installed.

Volume Purchasing Regions and cities could develop a bulk-purchasing program so that building owners can take advantage of volume discounts. Officials should carefully review product options in a transparent and open process to avoid "picking winners."

Non-Financial Incentives Incentives do not necessarily have to involve direct payments. Other methods can rely on building requirements as an incentive basis. For example, The City of Portland has implemented a Floor Area Ratio (FAR) bonus option to encourage vegetated roof development for the purposes of water runoff control. The FAR bonus allows the total area of a building to be larger than it might be otherwise if certain vegetated roof criteria are met. This incentive structure could also be used to support cool roofs.

Cities and regions may also offer priority or preferential permitting for buildings or development projects designed with a cool roof or pavements. Preferential permitting can be very valuable because it can shave considerable time off of the construction or retrofitting process.

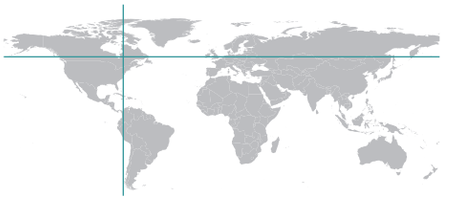
Case Study

Toronto, Canada: Eco-Roof Incentive Program

Dollar values in this case study are CAN.

Toronto Eco-Roof Incentive Program

Toronto, Canada
Mayor: Rob Ford
Population: 2.5 million (5.1 million metro area)
Coordinates: 28°36'N, 77°13'E



The Eco-Roof Incentive Program provides incentives for green and cool roofs to commercial, industrial and institutional property owners so that Toronto's building stock becomes more sustainable and better adapted to climate change. It was adopted by the Toronto City Council on December 1, 2008.

In May 2009, the City Council adopted the Green Roof By-Law and authorized a cash-in-lieu option for property owners that wished to opt out of building a required green roof on a new building. The cash-in-lieu is directed to the Eco-Roof Incentive Program to be used for green roof projects on existing buildings.

The Eco-Roof Incentive Program offers a $50 per square meter incentive, to a total of $100,000 for green roof projects on existing buildings, or a green roof on a new industrial building with a gross floor area (GFA) of 2,000 square meters or greater, or a green roof on a new institutional or commercial building with a GFA of less than 2,000 square meters. The incentive covers green roof projects on either existing buildings or new buildings that are not affected by the Green Roof By-Law.

Cricket Club, Toronto. Photo: Steve Pataki

The Eco-Roof Incentive Program also offers a $2 per square meter incentive for a cool coating over an existing roof or a $5 per square meter for a new cool roof membrane to a total possible incentive of $50,000. Cool roofs must be installed on an existing building in order to be eligible for funding. Funding for the cool roof portion of the Eco-Roof Incentive Program ended on December 31, 2011.

Since the program began in 2009, 92 Eco-Roof applications were received, 82 of which were approved for funding. There were eight approved applications where the project was ultimately not pursued. A total of 144,767 square meters of green and cool roofs have been approved with a total funding allocation of over $1.1 million. Of the approved eco-roof applications it is estimated that

- Green roofs reduced energy consumption on average by 11 kWh per square meter a year, helping to avoid on average 31 tonnes of greenhouse gas emissions annually.
- The combined green roofs divert between 7 and 8 million liters of stormwater from storm sewers annually.
- Cool roof installations reduced energy consumption on average by 1.72 kWh per square meter a year, helping avoid on average 38 tonnes of greenhouse gas emissions annually.

Toronto Sample Documents:

Link to a copy of the initial report online

Revisions to the program were made in February 2010. Link to updates online.

A copy of the report detailing the Green Roof By-Law

Share your experience

Building a global movement to transition our urban environments to cool surfaces will require that leaders document and share their experiences. If your experience is typical, you will have built relationships and received advice throughout the process of developing a cool program for your area. Be a part of that community by sharing your own successes. Contributing your experiences will help those that are just beginning their own programs and raise awareness about your program.

While your city or region is in the process of designing and launching your cool surfaces program, be sure to document all of your decisions and activities. Start documenting as soon as the process is underway. There are best practices and challenges at every stage; don't wait until the end to recap your success. This level of documentation can be streamlined by identifying a person or group responsible for tracking, developing, and disseminating case studies, presentations, and other materials. All materials developed should funnel through that office.

Volunteers in New York paint the roof of a charter school in Harlem to promote energy efficiiency as a solution to climate change. Photo: 350.org

As mentioned above, an important element of your cool surfaces program should be working with local researchers to instrument and monitor pilot projects, using standard monitoring protocols if possible, and to publish the resulting data. It is important that performance data is shared openly. If demonstration participants have privacy concerns, aggregate the data as needed.

Continuing education

This document has everything you need to get started, but we encourage you to continue to educate yourself, your colleagues, and your partners on the broad range of topics relating to cool roofs, cool pavements, and cool cities. Some of the information in this document is dynamic and will be updated periodically. Because we will not be able to update this document regularly, please visit CoolRoofToolkit.org to find updated material including building codes, incentives, active partners, and new resources.

The remaining pages of this document provide a list of case studies, a catalog of the links cited throughout the document, and references and notes. These resources are also available at CoolRoofToolkit.org, and will be maintained and updated there.

We look forward to working with you to help your city or region transition to cool surfaces and to hearing about your progress!

Building Materials

American Institute of Architects
aia.org

Center for Environmental Innovation in Roofing
roofingcenter.org

Cool California cool roof selection tool
coolcalifornia.org/finding-a-product

Cool Roof Rating Council
coolroofs.org

ENERGY STAR Reflective Roof Products
energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=RO

National Roofing Contractors Association
nrca.net

Polyisocyanurate Insulation Manufacturers Association
pima.org

Reflective Roof Coating Institute
therrci.org

Codes, Standards, and Ordinances

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
ashrae.org

Building Codes Assistance Project
bcap-energy.org

California Title 24
energy.ca.gov/title24/coolroofs/

DOE Building Energy Codes Program
energycodes.gov

Energy Efficient Codes Coalition
ase.org/programs/energy-efficient-codes-coalition

IECC
iccsafe.org

IgCC
iccsafe.org

USGBC LEED Standards
usgbc.org/LEED

Cool Cities

NYC °CoolRoofs
nyc.gov/html/coolroofs

Cool Roofs Economics and Financial Incentives

Cool Roof Calculator
roofcalc.com

Database of State Incentives for Renewables & Efficiency
dsireusa.org

Partners & Stakeholder Organizations

Business Council for Sustainable Energy
bcse.org

C40
live.c40cities.org/about-us

California Energy Commission
energy.ca.gov

Global Cool Cities Alliance
globalcoolcities.org

GLOBE Alliance
globealliance.org

ICLEI Local Governments for Sustainability
iclei.org

National Association of Clean Air Agencies
4cleanair.org

R20 Regions of Climate Action
regions20.org

The Foundation Center
foundationcenter.org

US Green Building Council
usgbc.org

World Green Building Council
worldgbc.org

Technical Resources and Information Hubs

California Energy Commission
energy.ca.gov

Clean Air World
cleanairworld.org

DOE Building Envelope and Windows R&D Program Blogeere
blogs.energy.gov/buildingenvelope

ENERGY STAR
energystar.gov

EPA Heat Island Effect
epa.gov/heatisld

EPA Mitigation Impact Screening Tool (MIST)
heatislandmitigationtool.com

EU Cool Roofs Council
coolroofs.univ-lr.fr

Federal Energy Management Program Cool Roof Resources
www1.eere.energy.gov/femp/features/cool_roof_resources.html

Global Eco-Cities Survey
2009.westminster.ac.uk/schools/humanities/politics-and-international-relations/eco-cities

Human Relations Area Files
yale.edu/hraf

Institute for Market Transformation
imt.org

Lawrence Berkeley National Laboratory Heat Island Group
heatisland.lbl.gov

NASA Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)
asterweb.jpl.nasa.gov

National Association of Clean Air Agencies
4cleanair.org

National Association of State Energy Officials
naseo.org

NOAA National Climatic Data Center
ncdc.noaa.gov/oa/ncdc.html

Oakridge National Laboratory Building Technologies Research and Integration Center
ornl.gov/sci/ees/etsd/btric

World Meteorological Organization
wmo.int

* This list of resources was developed in January 2012. Check www.coolrooftoolkit.org for an up-to-date list.

Get updates at

coolrooftoolkit.org

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