



KEEPING IT COOL

How Cool Roofs Programs Protect People, Save Energy and Fight Climate Change

Models to develop city cool roof programs in India

In India, nearly half a billion people live in rapidly urbanizing cities, with skyrocketing development, that converts open space into paved, heat-trapping roofs and roads. More than 60% of roofs are made from metal, asbestos, and concrete – trapping heat inside buildings. These hot surfaces worsen the heat island effect, drive temperatures higher, and lead to poor air pollution with greater energy needed to keep cool with fans and air-conditioning.

Cool roofs offer a simple and cost-effective solution to urbanization challenges. Cool roofs reflect sunlight and absorb less heat. Depending on the setting, cool roofs can help keep indoor temperatures lower by 2 to 5°C (3.6 - 9°F) as compared to traditional roofs.

Leading cities in India are developing and demonstrating cool roof programs for local conditions. For example, Ahmedabad has a cool roofs program for over 3,000 low income homes as part of its heat action plan. Hyderabad has a demonstration pilot aimed to design a broader program as part of its building energy efficiency program. The national government is working toward sustainable cooling with the National Cooling Action Plan and energy efficiency programs for buildings, air conditioners and fans.

This fact sheet outlines the need for cool roofs, how they work and their effectiveness, as well as, city program case studies and costs, and models for city programs. More information on cool roofs is available in the issue brief, *Cool Roofs: Protecting Local Communities and Saving Energy*.

 <p>PILOT MODEL Design and implement pilot programs to showcase benefits of cool roofs</p>	 <p>MUNICIPAL, VOLUNTARY AND CSR MODEL Implement cool roofs in municipal, government, corporate and low-income buildings</p>	 <p>BUILDING CODES MODEL Add cool roofs provisions to building codes and partner with real estate developers and residents for wider adoption</p>
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URBANIZATION CHALLENGES AND COOL ROOF SOLUTIONS

Urbanization brings skyrocketing development that converts open space into paved, heat-trapping surfaces like roofs and roads, leading to the heat island effect, where urban areas experience higher temperatures than their surroundings. More than 60% of the roof surface in urban India is constructed from galvanized metal, asbestos, and concrete. Collectively, these hot surfaces can worsen the heat island effect and lead to greater smog.

While climate change is making heat waves more frequent and intense, less than 10% of India's households have air conditioning. Access to affordable cooling is a matter of survival for millions of people in India. As living standards rise, demand for cooling and air conditioning will rise dramatically and threaten to strain the country's electric grid, worsen air pollution, increase fuel imports, and magnify the impacts of global warming.

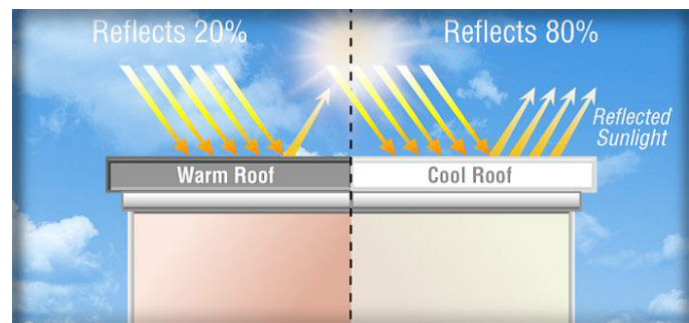
Cool roofs contribute to thermal comfort in homes, offices and other buildings and protect human health. By helping alleviate the urban heat island effect, and reducing electricity demand, especially during peak hours, cool roofs can further mitigate greenhouse gas emissions and air pollution. A study in Hyderabad found that cool roofs can reduce cooling energy demand by 10 to 19 percent in the top floor of buildings, potentially reducing citywide air temperature by 2°C (3.6°F). Scaling up cool roofs across the country has the potential to save over 700 GWh of energy use, avoid 0.60-0.65 million tons of carbon dioxide emissions, and save five billion rupees over 10 years, according to the same study. Cool roofs offer simple and effective protection from extreme heat especially for vulnerable communities in low-income housing.

HOW COOL ROOFS WORK AND WHY THEY ARE EFFECTIVE

Cool roofs are better at reflecting sunlight and absorb less heat. They are prepared, covered or coated with materials that have characteristics that enable them to warm up less than regular roofs. For example, reflective paint is a cost-effective cool roof coating.

Cool roofs function by reflecting solar radiation incident back into the atmosphere to a greater extent than a regular roof surface. The two most important factors that determine the effectiveness of a surface as a cool roof are its ability to “reflect” solar energy and “emit” absorbed energy. Cool roofs are effective in enhancing

thermal comfort within buildings, and reducing costs to run air conditioners, fans and other cooling appliances. Cool roof techniques can also help to enhance the durability of roofs and reduce peak power load on electricity grids.



How a cool roof works (image: IIIT, LBNL)

THE BENEFITS OF COOL ROOFS

- **Cool roofs save energy and costs by reducing cooling load requirements in a building:** By keeping the temperatures inside the top floor of a building lower, cool roofs reduce the need for air conditioning, providing more affordable cooling. They also reduce the energy loads in buildings that do have air conditioning.
- **Cool roofs help reduce the urban heat island effect, improve air quality and combat climate change:** By reducing the amount of heat gain in an urban area, cool roofs can mitigate the urban heat island effect and provide opportunities to reduce smog, air pollution and greenhouse gas emissions. By keeping city temperatures lower, cool roofs also help in reducing air conditioning energy consumption in buildings.
- **Cool roofs enhance durability and appearance of roofs:** By keeping roof structures from heating up through applying cool roofing techniques, cool roofs can prevent excessive expansion and contraction of the materials and reduce cracking incidences, prolonging the roof's life.
- **Cool roofs increase energy access by reducing peak load on the grid:** By reducing cooling needs in air-conditioned buildings, cool roofs can reduce peak load on the grid during the heat season, enabling lesser load shedding during the peak summer months.

- **Cool roofs help build community resilience to extreme heat:** As shown in the Ahmedabad Heat Action Plan, increasing community resilience to cope with heat waves can lead to fewer heat-related illnesses and casualties.

AHMEDABAD COOL ROOFS INITIATIVE

Since 2017, the Ahmedabad Municipal Corporation with partners Natural Resources Defense Council, the Indian Institute of Public Health – Gandhinagar, Mahila Housing SEWA Trust and others have included a cool roofs initiative as part of the Ahmedabad heat action plan for protecting communities from extreme heat. Ahmedabad’s initiative builds on extensive work by the Mahila Housing SEWA Trust who have installed over 100 cool roofs in low income communities in Ahmedabad, using a technology called ModRoof – roofs made of coconut husk and paper waste – as alternatives to traditional tin and asbestos roofs.

Key features of the Ahmedabad Pilot:

- **Pilot Size:** 3,000 roofs in 6 zones, expanding to include builder engagement
- **Implementation:** Ahmedabad city staff, along with 50 volunteer students from local colleges in Ahmedabad painted the roofs, and expanding to corporate social responsibility programs
- **Community Awareness:** Pamphlets, hoardings and communication materials on cool roofs to increase community awareness on what cool roofs are, how they can help keep indoor temperatures lower and what materials can be used to convert to a cool roof
- **Material and Cost:** Locally-available white lime paint that costs ₹ 1.50 (~\$0.02) per square foot for a total program cost of ₹ 700,000 (\$10,450); incorporated reflective paint coatings, and engaged 20-25 local real estate developers to expand cool roofs to private buildings in Ahmedabad on a voluntary basis



Gautam Shah, Mayor of Ahmedabad, paints the first cool roof in the city (photo: IIPHG-NRDC)

Hoarding/Billboard in Ahmedabad raising awareness on the positive effects of cool roofs in the city (photo: IIPHG-NRDC)

HYDERABAD COOL ROOFS INITIATIVE

As part of the state building energy efficiency program, the Greater Hyderabad Municipal Corporation, partnered with the Administrative Staff College of India, International Institute of Information Technology, and the Natural Resources Defense Council to implement a cool roofs pilot in a low-income neighborhood to showcase the benefits and impact of cool roofs in the city.

- **Pilot Size:** 25 city roofs in one low-income neighborhood
- **Implementation:** community members teams partnered with ASCI, IIIT, and NRDC to design, install and monitor results with inputs from Hyderabad officials
- **Material and Cost:** Dupont India supplied a high-density polyethylene (HDPE) cool roof membrane, Tyvek, for the pilot as a part of their corporate social responsibility efforts that actually retails in Hyderabad for ₹ 13/square foot (\$0.2/square foot)
- **Results:** indoor air temperature lower by an average of 2°C (3.6°F) observed in the homes with cool roofs as compared to similar homes without cool roofs
- **Resident Feedback Survey:** 76% of the trial group residents expressed enthusiasm for the cool roofs and others applied makeshift cool roof membranes to replicate cool roofs

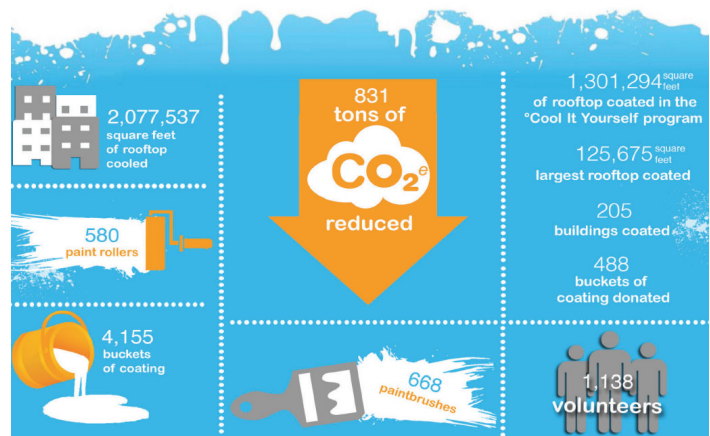


Pictures showing cool roof pilot installation and testing underway in Hyderabad, May 2017 (photo: ASCHIIIT-H)

NYC °Cool Roofs

Launched by New York City in 2009, NYC Cool Roofs is a program that paints rooftops across the city with white reflective coating that reduces energy consumption in buildings. The program has successfully coated over six million square feet of New York City rooftops and succeeded in reducing over 800 tonnes of carbon dioxide. Throughout the process, the initiative engages local property owners, community partners, workforce training organizations, and volunteers. New York City amended its building codes to include cool roof coating standards in 2009.

2013 NYC °CoolRoofs By the Numbers



Source: NYC Cool Roofs Program

MODELS TO DEVELOP A COOL ROOFS PROGRAM

Cool roofs programs can have great benefits citywide, and should be tailored to a city's needs and resources. Three emerging models exist: 1) pilot programs; 2) municipal, voluntary and corporate social responsibility (CSR) model; and 3) building code programs. These models for cool roof programs enable cities to steadily make progress while building community awareness and support.

These three models allow city cool roofs programs to grow from a single neighborhood to a city-wide effort. Identifying and mobilizing funding sources for each phase is critical to the program's success.

PILOT MODEL

Pilot programs are an effective tool to showcase the benefits of cool roofs. A pilot program is simple and quick to implement, demonstrates effectiveness of cool roofs in the local weather conditions, and can help spread awareness and bring in more stakeholders.

Key characteristics of a successful pilot program are:

- *Identify the location, size and partners.* Cool roofs pilot programs can be as small as a few houses or thousands of roofs. For example, ASCI, IIIT-H and NRDC worked on a 25-household pilot in Hyderabad, and AMC and IIPH-G worked on a 3,000-household pilot in Ahmedabad in 2017 and both have seen success.
- *Involve local stakeholders, tailor to local needs, and workforce training.* Engaging local experts, academic and research institutions, along with local businesses for material and workforce involvement with community awareness campaigns is a proven strategy.
- *Secure funding for a pilot program and connect to existing program.* Corporate social responsibility funds from businesses and/or city funds from related programs, such as health department efforts to reduce heat illness and deaths or state programs to advance energy efficient buildings, can provide seed funds for the pilot.
- *Monitor results and improve program design.* Studying the benefits and impacts of the program, including individual initiatives to expand cool roofs, is vital to scaling up efforts and overall program success.

MUNICIPAL, VOLUNTARY AND CSR MODEL

Starting with municipal and government buildings is a proven model to save energy, keep buildings cool, and showcase government leadership. Municipal buildings are often prominently located and can also serve to raise awareness of cool roofs. City funds and CSR funds are potential sources for implementing cool roofs in low-income communities.

Key characteristics of a successful voluntary and municipal buildings program are:

- *Identify government leadership and goal.* Efforts by dynamic city leaders that set targets for voluntary and municipal buildings program that involve local real estate developers and home owners to apply cool roof techniques on a voluntary basis.
- *Secure funding for program.* Municipal funds can be used for these programs, and depending on the material used, the payback period can be as little as a few months.
- *Local and community engagement.* Involving local workers to increase trained workforce for cool roofs in low income communities or areas that need to save energy the most.
- *Developer Engagement.* Encourage developers to use cool roofs especially on new construction, where the cost can be the lowest and the effectiveness can be highest.

BUILDING CODES MODEL

Incorporating cool roofs into building energy codes can be an effective way to expand cool roofs across a city or state. The Energy Conservation Building Code (ECBC) 2017 and Telangana State ECBC, enforced through Hyderabad's online compliance system, contain cool roof

How to Fund a Cool Roofs Program

Cool roofs are extremely cost competitive, and can be installed for as little as ₹0.50 (~\$0.07) per square foot for a coating of lime wash on an existing roof. In commercial, office and high-end residential buildings in India, cool roofs can reduce air-conditioning costs, peak power demand and improve the performance of the HVAC system.

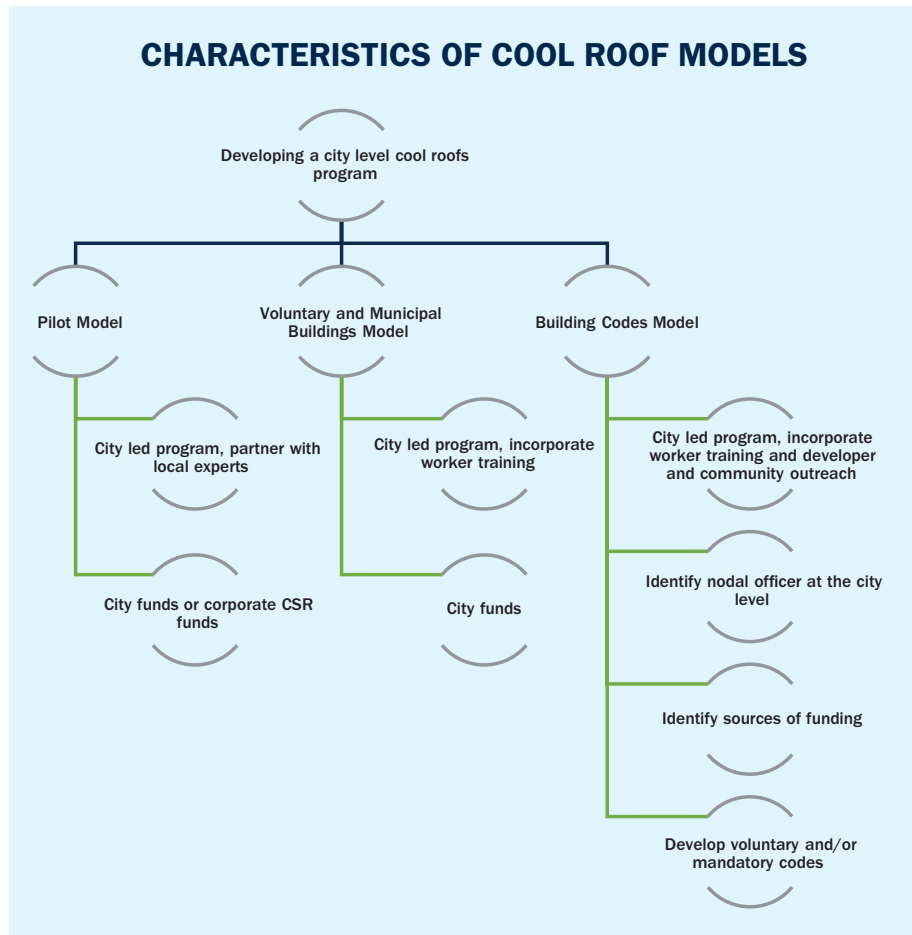
Examples of financial mechanisms:

- Allocating funds for cool roof programs in annual city budgets
- Utilizing public funds for health, energy or urban administration departments for pilot programs
- Leveraging Corporate Social Responsibility (CSR) funds for cool roof installations in low-income and vulnerable housing
- Property tax rebates for cool roof installation that key cities use to as incentives

provisions for commercial buildings.

Key characteristics of a successful building codes program are:

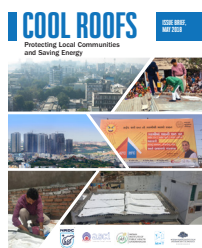
- *Include cool roofs into the city building codes.* Cool roofs can help meet either the prescriptive requirements or help the building meet the code on whole building energy simulation.
- *Select a nodal officer at the city level.* Appointing a nodal officer to oversee the program will enable different stakeholders to be well coordinated.
- *Identify funding for the program.* These could include city funds, CSR funds, and incentives to encourage adoption, as well as, simple measures such as property tax rebates can encourage greater adoption of cool roofs in a city.
- *Local workforce and materials.* Training the local workforce to install or paint cool roofs with locally available materials provides job creation and local economy creation opportunities.
- *Community outreach and monitoring.* Continually educating citizens about benefits of cool roofs and monitoring program implementation is vital to long-term success.



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Further reading



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Protecting Local Communities and Saving Energy

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