
MEMORANDUM

To: Environmental Quality and Sustainability Committee (“EQSC”)
From: Urban Heat Island and Tree and Shade Subcommittee
Date: Approved December 7, 2021
Re: Cool Roofs

The Urban Heat Island and Tree and Shade Subcommittee (“Subcommittee”) was tasked with providing information and recommendations to the Environmental Quality and Sustainability Committee related to cool roofs policy. This memorandum serves to provide the information requested by the EQSC, as well as to any relevant or interested stakeholders or City personnel.

When developing these recommendations, the Subcommittee obtained input from City of Phoenix staff from the Office of Sustainability, Office of Environmental Programs, Planning and Development Structural Engineering, the development community, and utilized expertise from the Subcommittee members themselves.

What are Cool Roofs?

Cool roofs are roofs designed with a “high solar reflectance.” In other words, a cool roof is one that has been designed to reflect more sunlight and absorb less heat than a standard roof.¹ Cool roofs can be made of a highly reflective type of paint, a sheet covering, or highly reflective tiles or shingles.

Typically, a cool roof is 65% or more reflective, whereas the standard roof is only 5% to 15% reflective. Standard or dark roofs can reach temperatures of 150 degrees Fahrenheit or more in the summer sun. A cool roof under the same conditions could stay more than 50 degrees Fahrenheit cooler.

Why Use Cool Roofs?

A cool roof can benefit a building and its occupants by:

- Reducing energy bills by decreasing air conditioning needs;
- Improving indoor comfort for spaces that are not air conditioned, such as garages or covered patios;
- Decrease roof temperature, which may extend roof service life.

Beyond the building itself, cool roofs can also benefit the environment, especially when many buildings in a community utilize the technology. Cool roofs can:

- Reduce local air temperature (known as the urban heat island effect);
- Lower peak electricity demand, helping to prevent power outages;

¹ U.S. Department of Energy, accessible at: <https://www.energy.gov/energysaver/cool-roofs>

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- Reduce power plant emissions, including carbon dioxide, sulfur dioxide, nitrous oxides, and mercury, by reducing cooling energy use in buildings.

New studies by the Department of Energy suggest that widespread adoption of cool roofs can also reduce the quantity of water needed for urban irrigation.² Notably, studies show that installing cool roofs and vegetation can lead to a measurable reduction in heat deaths by making the daytime weather conditions more tolerable. One study found that a realistic, 10% increase in reflectivity and vegetation could reduce heat death by up to 6%.³

In addition to these benefits, cool roofs are shown to be a cost-effective solution to mitigate heat in Phoenix. For every \$1 invested in implementing cool roofs throughout the Phoenix Metro Area, there is an estimated \$5.25 return on investment when considering the avoided losses from mortality, morbidity, labor productivity and energy demand.⁴ If even one third of roofs in the Phoenix Metro Area were cool roofs, we could save over \$280 million on an average annual basis by 2030 and if all roofs in the Phoenix Metro Area were converted to cool roofs by 2050, we could save nearly \$1 billion, from avoided losses from mortality, morbidity, labor productivity and increased energy demand.⁵

The City of Phoenix's Current Efforts with Cool Roofs

The City of Phoenix has adopted the 2018 International Building Code ("IBC") which contains requirements for a Solar Reflective Index ("SRI"). The existing IBC requirements for commercially owned flat roofs requires an SRI of 64, meaning that more of the sun's heat is required to reflect instead of absorb than previously required by prior IBC iterations. The lighter color of the roof means a higher index number. For example, dark roofs, in general, usually have an SRI less than 20, whereas a clean white roof could have an SRI of around 70-80.

It is the practice of the City of Phoenix to check that the base reflectance of roofs for new *commercial* construction meets the IBC standards before plan review. However, there are no requirements for "solar reflectiveness" for single family residential homes.

As to City-owned buildings, over 70,000 square feet of City properties have been painted with reflective cool roof coatings. These coatings have resulted in a 17% reduction in energy consumption for those participating buildings.

For all buildings in the City of Phoenix, a recent ASU class project found roughly 15,000 buildings with cool roofs in Phoenix, equating to approximately 3.5% of all buildings. The majority of those buildings with cool roofs tend to be found on large buildings.

² Department of Energy, accessed via: <https://www.buildings.com/articles/28239/benefits-cool-roofs>

³ Department of Energy, accessed via: <https://www.buildings.com/articles/28239/benefits-cool-roofs>

⁴ TNC, 2021: Economic Assessment of Heat in the Phoenix Metro Area [deBoer, A. Schwimmer, E, McGregor, A. Adibi, S. Kapoor, A. Duong, S. Love, J. Bonham-Carter, C. Lindquist, J.] In Phoenix, AZ

⁵ TNC, 2021: Economic Assessment of Heat in the Phoenix Metro Area [deBoer, A. Schwimmer, E, McGregor, A. Adibi, S. Kapoor, A. Duong, S. Love, J. Bonham-Carter, C. Lindquist, J.] In Phoenix, AZ



A white cool roof on the Phoenix Convention Center.

Photo: United Coatings

On October 12, 2021, the City of Phoenix passed the Climate Action Plan (“CAP”).⁶ As one of the Ongoing Actions, the City of Phoenix expressed its goal to continue to implement the Cool (Energy Star) Roofs on city-owned buildings. The CAP noted that cool roofs have been implemented for Public Works Department buildings since 2005. No other action plan regarding cool roofs was identified in the CAP.

What Can Be Improved?

The City of Phoenix CAP has been designed as a living document—with regular updates—able to continuously respond to the ever-changing and unique needs of our city. Including new cool roof goals in future iterations of the plan is one of many avenues available to progressing Phoenix’s approach to cool roofs policy.

Stakeholders in the commercial property development field have indicated to this Subcommittee that they prefer incentive-based programs as it relates to cool roofs, rather than a regulatory approach. However, cities that have established cool roof programs tend to use a combination of incentive, education, and regulatory-based approaches. An overview of the various approaches Phoenix could adopt are set forth below.⁷

Incentives

- *Financial 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.
- *Rebates.* Rebates are typically awarded on a per square meter or per square foot basis. For example, 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. Another example, Toronto’s Eco-Roof Incentive Program, offers

⁶ Available at: <https://www.phoenix.gov/oepsite/Documents/2021ClimateActionPlanEnglish.pdf>

⁷ This section was largely referenced from the Global Cool Cities Alliance’s Cool Roof Toolkit, available at: https://coolrooftoolkit.org/wp-content/pdfs/CoolRoofToolkit_Full.pdf

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.* Tax Incentives can be structured similarly to rebates, but provide small tax advantages instead of direct payments. There are a number of ways to organize tax programs. For example, property tax incentives could be offered for new or replaced roofs or resurfaced parking lots, or sales taxes could be waived on the purchase of cool roofing and pavement materials.
- *Volume Purchasing.* Phoenix could develop a bulk-purchasing program so that building owners can take advantage of volume discounts.
- *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.
- *Preferential Permitting.* Phoenix could also offer priority or preferential permitting for buildings or development projects designed with cool roofs. Preferential permitting can be very valuable because it can shave considerable time off of the construction or retrofitting process. **In the Subcommittee's discussions with commercial developer stakeholders, preferential permitting was one of the incentives specifically mentioned that stakeholders would respond positively to.**

Education

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 re-roofed frequently. An information campaign targeted at key decision-makers is an important element of developing support and momentum for cool surfaces. 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.

Regulations

There are a variety of ways that cool roofs may be incorporated into building and energy codes. For example:

- The 2007 Florida Building Code includes a credit for cool roofs in their performance-based requirements for residential buildings.

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- In Hawaii, prescriptive requirements for low-slope residential roofs include cool roofs as one of the four ways to meet the standard.
 - California has implemented residential cool roof requirements, depending on the region.
 - New York City implemented cool roof requirements for low-sloped roofs in January 2012. Their code addresses the many roof types and uses by including modifications for a variety of roof types and uses.
 - Washington, D.C. has implemented cool roof requirements for low-sloped roofs on commercial and residential buildings.

Recommendations

- 1. Establish Community Education and Outreach Programs.** Good education and training programs are critical to the success of any policy or initiative. For example, 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. We recommend the City use its established communication channels, supplemented by broader communication efforts, to describe the reasons for pursuing local cool roof efforts, provide details of new programs, and explain how to participate.
- 2. Pilot Incentive/Rebate Program.** Before community education can commence, the City should have specific programs developed that members of the public can opt into, such as tax incentives, utility rebates, or other corporate sponsorship opportunities. A utility rebate in partnership with public utility stakeholders could be an avenue to establish a successful rebate and incentive program.
- 3. Demonstration Projects.** Demonstrations of cool roof and pavement technology can provide important local performance data and, if in a high-profile location, can help raise interest and awareness. Since a primary goal 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. We recommend bringing 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. Identifying a neighborhood or region where the impact of cool surfaces would be the greatest for such demonstration projects, such as in heat-vulnerable communities like South Phoenix, will provide important data and case studies for ongoing research into the effects of heat in vulnerable communities. Demonstration projects should not be limited to commercial or multi-family residential sites, and single-family residential programs should be actively pursued.
- 4. City Council Workgroup.** A city-wide transition to cool roof materials will be accelerated if City leadership prioritizes and actively promotes the concept of “going cool.” Program implementation, such as the programs suggested in this section,

require discussion and planning regarding best practices for execution and enforcement. Support from top officials (Mayor Gallego and City Council members) with the establishment of a cool roof workgroup and other general support, will help secure buy-in across relevant City departments, and help raise awareness and visibility for cool roofs as an effective mitigation and adaptation strategy. The workgroup could also investigate sources of funding to assist in implementing any programs, including funds to encourage energy efficiency available in the 2021 “Infrastructure” Bill.

- 5. Additional Regulations for Multi-Family Residential.** One of the highest impact ways to support the rapid implementation of cool roofs is to include them in the City’s building code. Although making changes to the code can be a time-consuming process, there are several sources of model language which the City can draw from to use as a basis for local cool roofs. For example, the International Energy Conservation Code (“IECC”) contains model cool roof code for commercial and high-rise residential buildings with low-sloped roofs. Although cool roof language is integrated into the Commercial Building Code, one area where there is an opportunity for cool roof regulation is in multi-family residential construction, which is rapidly increasing throughout the City. Once codes are enacted, they must be monitored and enforced.

Conclusion

The gravity of climate change and its effect on Phoenix residents, particularly low-income and other vulnerable communities, demands expedited action by the City of Phoenix. The Urban Heat Island and Tree and Shade Subcommittee urges the City of Phoenix to continue its commitment to the Climate Action Plan and reducing the heat island effect by utilizing a combination of regulation, incentives, and education to enhance and expand its current cool roof program through the mechanisms offered above.