COOLING BEYOND THE BUILDING:

THE POTENTIAL FOR REFLECTIVE SURFACES TO COUNTER GLOBAL WARMING

It is well known that reflective surfaces help keep buildings cooler and reduce the costs and greenhouse gas (GHG) emissions from air conditioning, but is your cool roof also contributing to a cooler planet? A growing body of research highlights the ability of cool surfaces to reflect more sunlight, rather than absorb it, which means these surfaces return more of the sunlight back through the atmosphere and out into space, starting from the moment the surfaces are installed.

WHAT IS ATMOSPHERIC COOLING?

The Earth gets energy from the sun in the form of sunlight, also known as solar radiation. Increasing the fraction of solar energy that is reflected from the Earth's surface cools the planet's surface and the atmosphere. We can do so by replacing dark, more solar-absorptive surfaces with lighter, more solar-reflective surfaces, such as cool roofs.

In addition to potentially reducing new GHG emissions via energy efficiency, cool roofs could offset the warming effect of GHGs already in the atmosphere. Scientists have tried to quantify the global cooling effect in terms of offsetting GHG emissions since much of our climate policy and finance is based on GHG mitigation.

HOW MUCH ATMOSPHERIC COOLING IS POSSIBLE FROM COOL ROOFS?

It turns out, quite a lot. Efforts to quantify this effect concluded that the use of more solar-reflective surfaces in cities around the world could cancel the warming effect of 44–57 billion metric tons of emitted carbon dioxide—up to 55% more than the annual global emissions of carbon dioxide in 2022. At a building scale, that means that increasing the reflectivity of 1,000 ft^2 (93 m^2) of roof area could offset the warming effect of 10 tons of CO_2 emissions [1,2].

If all dark roofs were replaced with more solar-reflective roofs, the planet would immediately reflect more sunlight to space, cooling the atmosphere in a manner that is equivalent to removing

GHGs from the air. The roof's reflectance would need to continue to exceed that of the original dark surface to maintain the atmospheric cooling benefit over time.[1]

1. How to properly calculate and value albedo modification is an ongoing discussion amongst the scientific and finance communities.

Akbari, Menon, and Rosenfeld [1] found that even a modest increase in the solar reflectance of a roof surface can have a positive impact on reducing GHG emissions by lowering the building's cooling demand by reducing its solar heat gain, reducing peak demand, and increasing the community's albedo (solar reflectance).

Complex atmospheric dynamics may prevent highly reflective roofs from realizing the full global cooling potential attributed to them, but the fundamentals remain unchanged—cool roofs absorb less of the sun's energy, decreasing the amount of heat that gets trapped in the atmosphere, and help to cool the world and our homes.

REFERENCES

[1] H. Akbari, S. Menon, A. Rosenfeld, Global cooling: Increasing world-wide urban albedos to offset CO2, Climatic Change 94 (2009) 275–286. https://doi.org/10.1007/s10584-008-9515-9.

[2] S. Menon, H. Akbari, S. Mahanama, I. Sednev, R. Levinson, Radiative forcing and temperature response to changes in urban albedos and associated CO2 offsets, Environmental Research Letters 5 (2010). https://doi.org/10.1088/1748-9326/5/1/014005.

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