

WHITE ROOFS COOL WORLD EFFICIENTLY

I'm pleased to contribute to this *IEA Energy* issue on energy efficiency. Having devoted the past four decades of my career to energy efficiency, I can attest to the positive influence both of energy-efficient technologies and building and appliance standards that reduce energy consumption without compromising the quality of service.

My latest obsession is a campaign for white roofs in climates where summers are uncomfortably hot. White roofs not only reduce energy bills and dampen the urban heat island effect, but they also cool the world.

White roofs reduce heat load on buildings and cities ... and the world

On a clear day, a conventional dark roof can get 40°C to 50°C hotter than the outside air. A clean white roof, by comparison, runs only 5°C to 10°C warmer than the ambient air. This cooling from choosing a white roof over a dark one yields additive virtues. Well documented is the first – a cooler roof means that the space beneath the roof needs less electricity for air conditioning, saving money and avoiding emissions of CO₂ and other pollutants back at the power plant. Secondly, by reflecting more of the sun's energy back into space, white roofs cancel a small percentage of the heating effect from CO₂ that has already been emitted. This is called the "albedo effect", based on the Latin word for whiteness. As reflective arctic ice recedes rapidly, we need all the albedo we can get.

Together, these effects suggest that by installing a white roof to reduce a building's energy bill, you also contribute a free global cooling effect. Every 100 square metres of roof area that is white instead of black cancels the warming effect of 10 tonnes of CO₂ over the roof's lifetime (typically 20 years). With roofs accounting for roughly 25% of urban surface area and with cities occupying 1% to 2% of global land area, converting most flat roofs in warm cities to white would cancel warming from more than one gigatonne of CO₂ per year for the average lifetime of the roofs. In terms of emissions, it's equivalent to taking half the world's cars off the road for 20 years.

The role of standards and international co-ordination

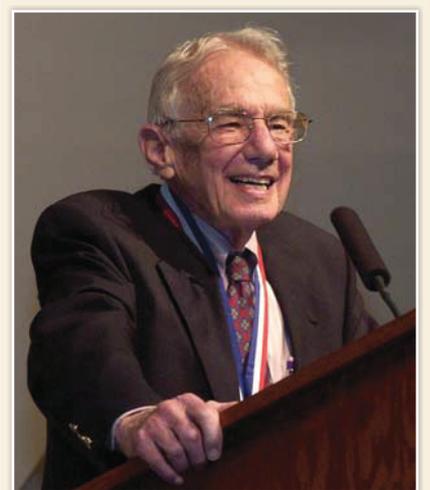
As Energy Commissioner in California in 2003, I was shocked by the 30 000 deaths caused by the infamous heat wave that engulfed Europe that August. So by 2005, I succeeded in making cool roofs a mandatory component of our building code. While it is not cost-effective to replace a roof before the end of its service life and sloped roofs were exempted because they are an important architectural element of a home, we passed a mandate that as of 2007 all new or replacement flat roofs in the state must be white.

The California white roof message reached the national stage when my friend Steven Chu, in his first year as US Energy Secretary, adopted California's requirements for all Department of Energy buildings that pass a life-cycle cost-effectiveness test.

Then in 2010 he helped launch the Global Cool Cities Alliance (GCCA), a private-public partnership for the worldwide promotion of cool-city policies, and designated GCCA the operating agent of a voluntary international working group on cool roofs and pavements. Such hot countries as India, Japan, Mexico and South Africa have joined, and Brazil and China are actively studying the issue.

Implementation

The easiest way to implement white roofs is through building standards, enforced wherever they are life-cycle cost-effective. White roofs are an example of how the IEA can help its members – but also, and in particular, hot, fast-growing, developing countries. 



By Arthur H. Rosenfeld

Arthur H. Rosenfeld fostered a number of critical energy efficiency breakthroughs at the Lawrence Berkeley National Laboratory in California. He has served as a senior adviser for the US Department of Energy and as Commissioner for the California Energy Commission. In February he received the US National Medal of Technology and Innovation for energy-efficient building technologies and related standards and policies; in 2011 Russia awarded him its Global Energy Prize.

For more information regarding cool roofs, visit the Lawrence Berkeley National Laboratory's Heat Island Group website at <http://HeatIsland.LBL.gov>. To learn more about the Global Cool Cities Alliance, see www.GlobalCoolCities.org and browse its technical implementation toolkit for cool roofs and pavements at www.CoolRoofToolkit.org. Finally, refer to www.ArtRosenfeld.org for recent presentations, papers, and pertinent resources by the author.