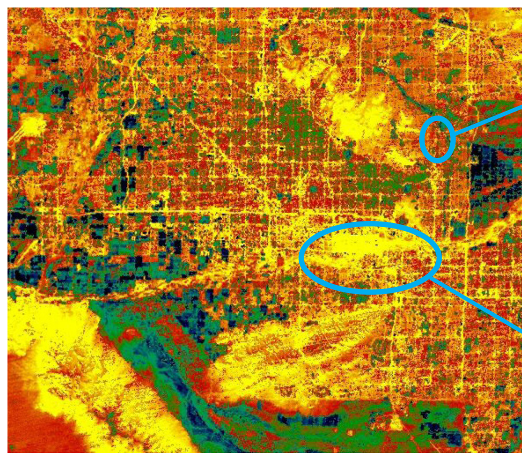
Mandating Pavement Brightness Is Bad Public Policy

Proposed legislation and building codes aimed at specifying how bright a pavement or hardscape surface should be are based on a flawed idea. Concrete pavement promoters have lobbied for such rules, alleging that pavements and hardscape surfaces with a solar reflectance value of greater than 29 would reduce the urban heat island (UHI) effect.

Because asphalt pavements are naturally darker, mandates for reflectance in legislation or building codes would amount to a legislated mandate for concrete, no matter which material better suits the engineering needs of a specific project. This subjective reflectivity criterion is based upon thin science that has not been peer-reviewed or actually validated in the field. It would be bad public policy to implement such mandates.

The National Asphalt Pavement Association strongly supports a robust, rigorous research program to understand the real impacts that pavement color, mix design, porosity, and depth have on urban heat islands and to explore potential cost-effective solutions. In the meantime, NAPA points out that objective research has proven the benefits — including verified reduction in UHI and stormwater pollution control — of porous, permeable, and pervious hardscape surfaces.



The biggest heat island in the Phoenix, Ariz., metropolitan area is Phoenix Sky Harbor International Airport, with its thick concrete runways. North Scottsdale Road, which is made of asphalt, is demonstrably cooler in this NASA ASTER Night Surface Temperature image.

Proposed legislative and building code language requiring reflective pavements is not based on robust, peer-reviewed science and would be costly to implement and maintain. Unlike permeable pavements (e.g., porous asphalt and pervious concrete), which have been shown to mitigate UHI, there is no conclusive evidence that reflectivity requirements would reduce either building cooling loads or UHI. Absent unbiased research on this subject, pavement reflectivity mandates are scientifically unfounded, biased, and arbitrary and they should be removed.

Instead of focusing on reflectivity or brightness, efforts seeking to address UHI should follow the example of ANSI/ASHRAE/USGBC/IES Standard 189.1-2011 and adopt permeable pavements as the preferred pavement technology for UHI mitigation.

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The following facts should be considered before any legislation or codes that mandate specific solar reflectance criteria for a pavement or hardscape surface are adopted.

- ➔ An urban heat island (UHI) is a metropolitan area that is significantly warmer than its surrounding rural areas. The main cause of the urban heat island is modification of the land surface by urban development which uses materials which effectively retain heat. Waste heat generated by energy usage is a secondary contributor. UHI was first identified in the early 1800s, long before asphalt was widely used for paving.
- ➔ Reflectivity criteria were developed for roofing materials after it was determined that dark-colored roofs tend to transfer heat into a building. Highly reflective roofs may reduce the cooling load of a building.
- ➔ The theory that pavement reflectivity may have an impact on UHI was modeled from roofing data, but pavements are not roofs and they serve a different function. Pavements are constructed at ground level, unlike roofs, which are built atop buildings and may act as either a heat collector or an insulator for the facility.
- ➔ Although the surface temperature of darker objects is warmer than lighter surfaces, there is no evidence that a pavement's surface temperature can increase the cooling load of adjacent buildings, let alone contribute to the overall UHI effect. However, ongoing research indicates that reflective pavements may actually *increase* the cooling loads of adjacent buildings due to reflected sunlight.
- ➔ Research at Stanford University indicates that reflective surfaces, like roofs, may actually increase global climate change by heating up the atmosphere.[1]
- ➔ Permeable pavements, such as porous asphalt, have been shown to reduce pavement surface temperatures more than traditional concrete pavements.[2,3] They are also recognized by the U.S. Environmental Protection Agency as a best practice for stormwater management.[4]
- ➔ Research at Clemson University and other institutions indicates that permeable pavements, either concrete or asphalt, are more effective than reflective surfaces for minimizing surface heating.[5] Arizona State University has also shown that an open-graded or porous surface treatment reduces pavement surface temperature, which could minimize UHI.[6]
- ➔ Neither pervious concrete nor porous asphalt typically meet a reflectance standard of greater than 29 percent due to irregular surface texture.[7] Mandating highly reflective surfaces could therefore have the unintended consequence of removing permeable pavements from the list of options for both stormwater management and UHI reduction.
- ➔ A number of federal agencies recommend against using reflective pavements in areas like schoolyards where there is the potential for adverse health effects from reflected solar radiation.[8,9,10]
- ➔ Mandating a pavement reflectivity criterion based on limited science would restrict engineers and architects in their consideration of specific paving materials. Additional considerations that may be important to a project include use of local materials, life-cycle costs, maintenance, stormwater management, and safety. Mandated reflectivity will limit market competition, raising costs for taxpayers and preventing the use of the most appropriate material for a project.
- ➔ A new green building standard, released by ANSI/ASHRAE/USGBC/IES as a jurisdictional compliance option for the International Green Construction Code (IgCC), now recommends that permeable pavements be used to mitigate the heat island effect to "meet a minimum percolation rate rather than a minimum solar reflectance index."[11]
- ➔ Over time and with use, the difference in reflectivity of different pavement materials becomes less.[12] Brighter pavements, such as concrete, darken over time while darker asphalt pavements become lighter over the same period. In addition, maintaining a bright pavement over its use phase is very costly.
- ➔ The hottest heat signature in the Phoenix, Ariz., metro area is Sky Harbor International Airport with its thick concrete runways, showing that factors other than pavement brightness and solar reflectivity have an impact on surface temperatures.[13,14,15]
- ➔ Proposed reflective pavement legislation and codes fail to consider the entire life cycle of pavements, including the production of materials and disposal at end of life. Asphalt is the most recycled and reused material in the United States. Other pavement materials are disposed of in landfills or dumped into the ocean. Asphalt pavement has a very small overall carbon footprint.

SOURCES: [1]Stanford University (2011, October 20). "Urban 'heat island' effect is a small part of global warming; white roofs don't reduce it, researchers find." *ScienceDaily*. Retrieved from http://www.sciencedaily.com/releases/2011/10/111020025802.htm [2]Golden, J.S. & Kaloush, K.E. (2005, December 1). "A hot night in the big city: How to mitigate the urban heat island." *Public Works Magazine*, Retrieved from http://www.pwmag.com/industry-news.asp?sectionID=760&articleID=268116 [3]Stempihar, J.J., Pourshams-Manzouri, T., Kaloush, K.E., & Rodezno, M.C. (2012, January). "Porous asphalt pavement temperature effects for urban heat island analysis." Paper presented at Transportation Research Board 91st annual meeting, Washington, DC. [4]U.S. Environmental Protection Agency (2011, August 16). "Stormwater Management Best Practices." Retrieved from http://www.epa.gov/oaintrnt/stormwater/best_practices.htm [5]Duncan, D., & Putman, B. (2012, January). "The effect of porous pavements on near surface air temperatures." Paper presented at Transportation Research Board 91st annual meeting, Washington, DC. [6]Golden & Kaloush (2005) [7]Boyer, M. (2011). Preliminary analysis of summertime heat storage in traditional versus pervious concrete systems. (Unpublished master's thesis, Washington State University) Retrieved from http://www.dissertations.wsu.edu/Thesis/Spring2011/m_boyer_040611.pdf [8]Cambridge Systematics Inc. (2005). *Cool pavement report: EPA cool pavements study – Task 5*. Retrieved from http://www.epa.gov/heatisld/resources/pdf/CoolPavementReport_Former Guide_complete.pdf [9]U.S. Centers for Disease Control and Prevention (2008). *Shade planning for America's schools*. Retrieved from http://www.cdc.gov/cancer/skin/pdf/shade_planning.pdf [10]Canadian Centre for Occupational Health and Safety (2010, April 20) "OSH answers: Skin cancer and sunlight." Retrieved from http://www.ccohs.ca/oshanswers/diseases/skin_cancer.html [11]ASHRAE and U.S. Green Building Council (2012). *Standard for the design of high-performance, green buildings except low-rise residential buildings (ANSI/ASHRAE/USGBC/IES Standard 189.1-2011).* [12]Cambridge Systematics Inc. (2005) [13]Pitzl, M.J. (2004, August 20). "ASU, developers, cities search for ways to get valley off heat islands." *The Arizona Republic*. Retrieved from http://www.azdot.gov/quietroads/nrel_082004.asp [14]Duncan & Putman (2012) [15]Golden & Kaloush (2005)