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January 27, 2014

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Dear Dr. Dirks,

I am writing to make you aware of some serious problems with *Unintended Consequences*, a research synthesis released in October 2013 by Jiachuan Yang, Dr. Zhihua Wang, and Dr. Kamil Kaloush of the Arizona State University National Center of Excellence for SMART Innovations (the Center) for the National Asphalt Paving Association and other related industry groups.

Releasing *Unintended Consequences* through Arizona State University allows the paper to undeservedly trade on the strong academic reputation of the school. Arizona State University has developed a position of academic, research, and intellectual leadership in solar energy and sustainable building design. Given the raft of inaccuracies in this University-branded study and the commercial conflicts of interest, we would strongly recommend that the Center retract *Unintended Consequences* or submit the paper for peer review in order to protect your institutional reputation.

The authors of *Unintended Consequences* assert that reflective roofs and pavements have substantial negative consequences on building systems, human health, building energy use balance in northern climates, and global climate. In fact, a more careful review of the research cited in the paper and of the large body of scientific research on reflective surfaces that the authors chose not to reference, indicate positive impacts on energy use, human health, and global climate change. The robust market for reflective products and the growth in urban heat island mitigation policy further substantiates that, in most climates, increased use of reflective surfaces reduces energy use, improves air quality and reduces emissions of greenhouse gasses.

*Unintended Consequences* is a biased, misleading, and error-riddled industry white paper written for and with funding from the National Asphalt Paving Association in order to discredit the energy, climate, and health benefits of reflective roofs and pavements. Rather than undertake a balanced review of available literature, the authors “cherry pick” findings out of context, ignore a significant number of peer reviewed studies that do not support their claim, and mischaracterize the findings of many studies that are cited.

Attached with this letter is a comprehensive fact check of *Unintended Consequences* that was developed by my organization and a group with technical expertise in pavements, climate modeling, building science, reflective surfaces, and urban heat islands. *Unintended Consequences* contains about 60 major errors – that is 6 per page. We are more concerned with the way the authors misleadingly or incompletely

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summarize research in order to reach their preconceived conclusions about reflective roofs and pavements. Here are just a few examples that highlight the types of problems in the paper that lead us to question the scientific validity of the authors' approach:

- *The authors draw many incorrect conclusions from the cited research.* In claiming that reflective roofs will lead to greater heating energy penalties than cooling energy savings, the authors note that total heating energy use is greater than total cooling energy use in U.S. buildings. Total building energy use has nothing to do with the net energy savings from reflective roofs. Models and field studies clearly show that, in most cases, reflective roofs reduce net energy use in buildings, even buildings that use more energy for heat.
- *The authors make significant factual errors throughout the study.* For example, the authors cite the radiative forcing from cool roofs and pavements Akbari et al (2009)<sup>i</sup> as an annual value, rather than a one-time benefit. In another case, the authors warn that increasing the reflectivity of roofs and pavements could lead to a substantial reduction in precipitation. However, the cited studies (e.g., Bala & Nag (2012)<sup>ii</sup>) evaluate a global negative radiative forcing that is nearly 50 times greater than what would be possible from an increase in roof and pavement reflectivity worldwide.
- *The authors exclude key details that are needed to understand the conclusions of the research cited.* In a section on roof condensation, the authors state, (emphasis mine) “A field study by Ennis and Kehrer (2011)<sup>iii</sup> also reports that condensation is *only* found on the back side of highly reflective membranes.” They fail to mention that the field study *only* evaluated highly reflective membranes. The cited study also ran models that found that roofs with either dark or reflective membranes accumulate some moisture and dry out completely over the course of the year.

If *Unintended Consequences* is an industry white paper developed to support asphalt industry marketing efforts, the Center has an ethical obligation to Arizona State University and to its audience to clearly state that. At a minimum, the paper should be publicly recalled to fix the errors we have highlighted. I am happy to discuss our concerns in more detail if you wish.

Best regards,

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cc: Dr. Ann Kinzig, Dr. Christopher Boone, Dr. Paul Johnson, Dr. Kamil Kaloush, Dr. Zhihua Wang

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<sup>i</sup> Akbari H, Menon S, Rosenfeld A. 2009. Global cooling: increasing world-wide urban albedos to offset CO<sub>2</sub>. *Climatic Change*, 94(3-4): 275–286. doi:10.1007/s10584-008-9515-9

<sup>ii</sup> Bala G, Nag B. 2012. Albedo enhancement over land to counteract global warming: impacts on hydrological cycle. *Clim. Dyn.*, 39(6):1527–1542. doi:10.1007/s00382-011-1256-1

<sup>iii</sup> Ennis M, Kehrer M. 2011. The effects of roof membrane color on moisture accumulation in low slope commercial roof systems. Proceedings of the 2011 International Roofing Symposium, Washington, DC, Sept. 7–9. [http://staticcontent.nrca.net/masterpages/technical/symposium/pdf/25\\_ennis\\_paper.pdf](http://staticcontent.nrca.net/masterpages/technical/symposium/pdf/25_ennis_paper.pdf)