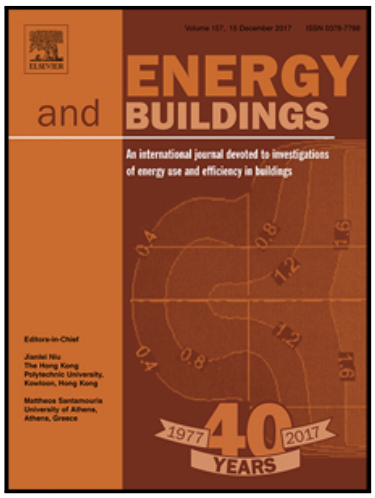

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PII: S0378-7788(18)32143-1
DOI: https://doi.org/10.1016/j.enbuild.2018.08.048
Reference: ENB 8784

To appear in: *Energy & Buildings*

Received date: 13 July 2018
Revised date: 29 August 2018
Accepted date: 29 August 2018

Please cite this article as: Amir Baniassadi , David J Sailor , Peter J Crank , George A Ban-Weiss , Direct and indirect effects of high-albedo roofs on energy consumption and thermal comfort of residential buildings, *Energy & Buildings* (2018), doi: https://doi.org/10.1016/j.enbuild.2018.08.048

Direct and indirect effects of high-albedo roofs on energy consumption and thermal comfort of residential buildings

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Abstract: Over the past three decades, high-albedo roofing has been promoted as a strategy to mitigate the urban heat island effect and reduce cooling energy demand and costs. In addition, high-albedo roofs can increase thermal comfort in non-conditioned buildings. Energy saving and thermal comfort benefits from these roofs have two components: 1- Direct benefits to individual buildings by reducing absorbed shortwave radiation through the roof, and 2- Neighborhood-scale indirect benefit resulting from reduced ambient air temperatures, particularly when high-albedo surfaces are deployed on a large scale. This study is an effort to quantify the relative importance of these direct and indirect benefits and identify how they are affected by building and climate characteristics. We used whole-building energy simulations of a set of archetypical single family residential buildings in three locations with distinct characteristics within the Los Angeles area (one coastal, and two inland). Our simulations show that benefits from the indirect effect can be the same order of magnitude as the direct effects. More importantly, these benefits depend on the climate and building characteristics. The highest energy and thermal comfort benefits were observed in a low-performance building (defined by airtightness and ceiling insulation level) in Long Beach, where simulations indicated an energy savings of 41 % and thermal comfort improvement of 23 % due to a combination of direct and indirect effects.

Keywords: High-albedo roofs – Building Energy Consumption – Thermal Comfort – Urban Climates – Cooling demand – Energy Cost

Declarations of interest: none