Feature

An Updated Holistic Look at Old Assumptions: Insights from Three New Studies on Roof Albedo

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THE GROWING AWARENESS of climate change, as well as the related issues of urban heat islands and steadily increasing energy costs, has led to a growing interest in the effectiveness of reflective, or "cool" roofs (i.e., roofs that are designed to reflect more sunlight and therefore absorb less solar energy than a conventional roof). Proponents of reflective roofs have recommended their use throughout the US to save energy and mitigate the effects of urban heat islands (UHIs), and some cities have moved toward mandating the use of white roofs on all new construction, roofing removal, and replacement as well.

Because EPDM Roofing Association (ERA) members make a variety of roofing membranes of various colors and roofing products used in countless geographic locations and building types, ERA's members believe it is incumbent on policymakers to verify the purported advantages of cool roofs and ensure that building owners and designers are free to decide how best to use EPDM roofing products to meet their roof performance and sustainability goals. ERA members contend that two fundamental questions should be answered before additional mandates are enacted. First, do reflective or cool-roof mandates in a given locality have the desired impact of reducing or limiting the development of UHIs? And second, to what extent is there sufficient certainty in the protocol by which UHI is quantified to determine this at all? Does roof albedo or insulation matter more in achieving improved energy efficiency?

Recently, ERA turned to researchers in Clemson University's Department of Construction Science and Management and ICF, one of the nation's foremost energy and environment consulting firms, to answer these questions. This research, which was conducted from 2019 to 2023, includes a critical review of the relevant literature by the Clemson University researchers titled "The Impact of Membrane Color and Roof Albedo on Energy Efficiency and Urban Heat Islands,"[1] and two original studies by ICF: "Assessing the Effects of Local Cool Roof Policies on Urban Heat Islands"[2] and "A Comparison of Code-Compliant Roof Insulation and Roof Albedo Impacts and Benefits on Energy Efficiency."[3]

Based on the results of these studies, the ERA recommends that policymakers pause the implementation of policies that require reflective roofing mandates and calls upon government agencies, nongovernmental organizations, and other stakeholders to conduct additional research to assess the relative value of every tactic that could be used to diminish the impact of UHIs and increase building energy efficiency.[4]

As the research suggests, many questions need to be answered before the real-world implications of one-size-fits-all reflective roofing mandates can be understood and evaluated. This article aims to begin that process by presenting the current research on the presence of cool roofs as tools to mitigate UHIs and enhance the energy efficiency of buildings, identifying areas for improving cool-roof research, and predicting the policy implications of enacting one-size-fits-all roofing mandates.

UHI research lacks consistent methodology, hindering real world applications.

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LITERATURE REVIEW: THE IMPACT OF MEMBRANE COLOR AND ROOF ALBEDO ON ENERGY EFFICIENCY AND URBAN HEAT ISLANDS

The ERA contracted with researchers in Clemson University's Department of Construction Science and Management to conduct a critical review of the published data and literature about the impact of membrane color on energy efficiency and UHIs, synthesize the findings from that literature, and identify gaps in the existing research. After examining more than 2,856 references, 178 articles and papers, and 102 original research studies, the researchers identified questions about the use and benefits of cool roofs that require additional and deeper study.[5]

Overview of Research on the Impact of Cool Roofs on UHI and Energy Efficiency

According to the researchers, studies examining the impact of cool roofs on UHIs presented mixed results, as there are a range of factors, including landscape, density, geographic location and climate, and more, that contribute to the severity of UHIs. For example, many of the studies the researchers reviewed were dated (that is, published at least a decade ago) and therefore failed to consider factors relevant to UHIs, such as the impact of high vehicular emissions on temperatures in areas with high density, the effect of hardscape asphalt surfaces compared to roofs, and the influence of building height. Further, the researchers reported instances in which more recent studies based their conclusions on these earlier studies, which now must be considered dated or offering incomplete information.[6]

The researchers observed that conclusions about the effect of membrane color on energy efficiency would benefit from additional and more timely research to support or refute currently held perceptions, such as the notions that increased levels of reflectivity increase the amount of annual energy savings, and that roof insulation is critical in all climates. New research, they suggest, should compare the impact of roof albedo on energy efficiency for real-world versus simulation-based studies, for these simulation-based studies did not account for aging, soiling, and weatherability of the "cool" material during a building's life span.[6]

Research Gaps and their Impact on Implementation

Although there is an abundance of current research that examines the impact of cool roofs on building performance, energy efficiency, and UHIs, there are gaps and inconsistencies in their research methodologies that limit the application of their findings in real-world settings. The effectiveness of cool roofs in addressing these issues very much depends on a combination of factors that are unique to each city and/or geographic location, and thus incongruous with one-size-fits-all roof mandates.[6]

COMPARATIVE ANALYSIS OF THE EFFECT OF LOCAL COOL-ROOF POLICIES ON URBAN HEAT ISLANDS

To better understand the measurable impacts of commercial roofing surfaces on urban heat islands (UHIs), ERA contracted with ICF, one of the nation's foremost energy and environment consulting firms, to undertake a three-phase study designed to assess whether cool-roof mandates help mitigate UHIs (phase 1), determine whether the proliferation of cool roofs in a particular city positively impacts the UHI effect with improved analytical rigor (phase 2), and compare the strength and significance of daytime and nighttime UHIs to determine whether increases in cool roofs within help mitigate UHIs within particular cities (phase 3). The following is a summary of the methodologies used to conduct this three-part study and its conclusions.[7]

Phase I: Analysis of Select Cities with Reflective-Roof Mandates

In phase 1, ICF researchers analyzed ambient temperatures in three urban areas that have had cool-roof mandates in place, compared those temperatures to temperatures in three similar localities that have not imposed such mandates, and analyzed corresponding changes in urban land surface color in those localities to estimate the effect of commercial roof solar reflectance on UHIs. Experimental and control city pairs were selected to enable the comparison of impacts between cities with and without cool-roof mandates. Selection considered year of cool-roof mandate implementation and mandate coverage; availability and resolution of air temperature and GIS (geographic information system) data, both before and after mandate implementation; and climate conditions, including a city's international climate zone and microclimate, to moderate impacts confounding weather effects. The selected experimental (or mandate) cities and control city pairs were New York City, NY (mandate city) and Newark, NJ; Chicago, IL (mandate city) and Indianapolis, IN; and Washington, DC (mandate city) and Baltimore, MD.[8]

COOL ROOF MANDATES & UHI — PHASE I

No decrease in daytime UHI was observed in any city pair after the imposition of a cool roof mandate.

Phase 1 Results

Comparison of the cities with and without mandates revealed no discernible correlation between the imposition of cool-roof mandates and UHIs. As the ICF researchers state:

- None of the three city pairs exhibited a relative reduction in daytime UHI intensity after the experimental city imposed a cool-roof mandate.
- Only one of three city pairs exhibited a relative reduction in nighttime UHI intensity after the experimental city imposed a cool-roof mandate.
- Three out of 12 cases (daytime and nighttime UHI intensity for each of the six cities) showed a negative trend between UHI intensity and relative change in cool roof, indicating an uncertain, or at best, a low and localized impact on UHIs from the imposition of cool-roof mandates.[8]

Phase 2: Analysis of Cities with High UHI and Reflective Roofing Mandates

The aims of phase 2 were similar to those of phase 1: assess the relative impact of commercial cool roofs on UHIs. However, the second analysis was designed to improve analytical rigor; specifically, ICF proposed the use of higher-resolution imagery to enable more rigorous analysis of the areas of interest and yield results more meaningful to stakeholders.[9]

To accomplish these objectives, two cities, Chicago, IL, and Portland, OR, were selected for analysis because their high amounts of white roofing and UHIs made them good candidates for evaluating whether there are perceptible effects from the installation of commercial cool roofs on local UHIs. In addition, ICF's preliminary analysis of NOAA weather station and GIS data indicated that both cities have good availability of local weather stations with complete data and high-resolution GIS data complete with building layers for commercially zoned areas of interest.[9]

Phase 2 Study Results and Conclusions

Air temperature analyses conducted for Chicago and Portland for daytime UHIs were deemed inconclusive because they resulted in considerably lower estimates of UHIs than

COOL ROOF MANDATES & UHI — PHASE II

UHI measurements for Chicago and Portland were significantly less than those cited in the CCCSP even though the same methodology was followed.

presented in the commonly cited climate science publication (CCCSP), and the scenarios analyzed exhibited variable trends with uncertainty. However, the researchers decided that their findings may be reasonable and accurate even if they contradict findings in the CCCSP from which the methodology to measure UHIs was taken.[9]

According to EPA, UHIs are often strongest at nighttime because the built environment cools and releases heat to the atmosphere much slower than the surrounding rural areas, and daytime UHI can even be negative as the rural landscape heats up faster than the urban environment. Similar impacts were noted in the ICF analysis, where the daytime day-to-day UHIs were highly variable with as many days exhibiting positive as negative UHIs.[9]

Because there is no standardized method for determining UHIs, the researchers found UHIs to be contextual and based on the needs and objectives of those performing the study. Therefore, while different teams of researchers used multiple definitions and methods to quantify UHI, the ICF researchers believed it was reasonable to conclude that Chicago's and Portland's daytime UHIs (as determined through air-temperature analysis) were less pronounced than indicated in the CCCSP, even though they followed its methodology.[9]

Phase 3: Comparative Analysis of Daytime and Nighttime UHI

In Phase 3 of the research, 13 cities—Albuquerque, NM; Baltimore, MD; Buffalo, NY; Columbus, OH; Denver, CO; Kansas City, MO; Las Vegas, NV; Louisville, KY; Minneapolis, MN; Philadelphia, PA; Portland, OR; San Diego, CA; and Washington, DC—underwent a temperature-based UHI analysis that evaluated daytime and nighttime changes in UHIs on an annual basis over a period of more than a decade. The researchers mirrored the CCCSP's methods by looking at the strength and significance of daytime and nighttime UHIs and assessing the probability of a UHI being as prominent through the use of alternate weather stations and summertime periods.[10]

COOL ROOF MANDATES & UHI — PHASE III

Daytime measurements in the 13 cities were highly variable, with consecutive days flipping between positive and negative UHIs.

COOL ROOF MANDATES & UHI — CONCLUSIONS

1. Other major factors impact UHI, not just low-slope roofs.
2. The impact of cool roof mandates on UHI is inconclusive.

Because confidence in estimating UHI is central to the objectives of this study, the researchers found the following notable:[10]

- Daytime UHI was found to be less pronounced and more variable when compared to nighttime UHIs, which tend to be significant and positive.
- Due to the absence of a standardized approach for assessing UHI, its determination is contextual and depends on the specific requirements and goals of the researchers.
- Daytime UHI was not strong when compared to results from the CCCSP, and results vary greatly according to weather station selection.
- On a day-to-day basis, daytime UHI was highly variable, with instances where consecutive days flipped between positive and negative UHI.
- Air temperatures recorded at weather stations are influenced primarily by local conditions and rarely factor in surrounding areas.
- Daytime UHI also varied according to the quantity of weather stations and selected time period.

Overall Conclusions of the Impact of Cool-Roof Mandates on Urban Heat Islands

Given the results of the three-phase study, an increased presence of cool, white, or reflective roofs, whether by mandates or market occurrence, does not mitigate the effects of UHIs. As noted previously, as there is no established method for determining or analyzing Urban Heat Islands (UHIs), prior research on UHIs has been identified as context-dependent, shaped by the unique needs and objectives of the researchers conducting each individual study. As such, the ICF researchers noted that there is a great need among the scientific community to establish standardized and reproducible methods for defining and measuring UHIs that will yield reasonably consistent results.[11]

The researchers note that several themes remained consistent throughout all three phases:[12]

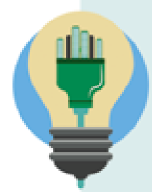
- There are many factors that impact UHI, only one of which is commercial rooftops.
- Daytime UHI was more variable and less pronounced than nighttime UHI.
- There is a need for stronger and higher-quality daytime UHI calculations.
- Air temperatures only reflect conditions near weather stations and not broader areas.
- Analysis of daytime UHI shows inconsistent results and is influenced by many factors.
- The impact of cool-roof mandates on UHI is inconclusive and requires more research.

A COMPARISON OF CODE-COMPLIANT ROOF INSULATION AND ROOF ALBEDO IMPACTS AND BENEFITS

Cool roofs have become one of several accepted strategies for mitigating the impacts of urban heat islands and have long been a prescriptive requirement of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1–2022, *Energy Standard for Buildings Except Low-Rise Residential Buildings*[13] and the *International Energy Conservation Code* (IECC)[14] in Climate Zones 1, 2, and 3. These requirements generally mandate a white or high-albedo roofing surface material that reflects a portion of the incoming solar radiation away from a building's roof, before it is transmitted to and absorbed by the building.

Cool roofs are currently not required by ASHRAE 90.1–2019 nor the IECC in Climate Zone 4 and zones to the north, as the reduction in solar heat gain from cool roofs tends to increase the overall building energy use in cooler to cold climates.

To better understand and communicate where insulation and cool roofs provide the greatest benefits, ERA commissioned ICF to conduct a study designed to assess and quantify the life-cycle energy, economics, and emission benefits of code-compliant roof replacements and cool-roof projects for a select number of commercial building types constructed with low-sloped roofs and representative city/climate zone



ROOF ALBEDO, INSULATION, & ENERGY EFFICIENCY

Researchers developed building energy models to calculate energy cost savings, produce lifecycle economic metrics, and develop emissions benefits.

combinations. The following is a summary of how this study was conducted and its conclusions.[15]

To determine where insulation and cool roofs provide the greatest benefits, ICF developed a three-step approach designed to accomplish the following:[16]

- Develop building energy models to represent the baseline and intervention scenarios. Both sets of models were simulated to produce annual estimates of whole-building energy use and their energy use was subtracted to produce incremental energy savings.
- Calculate energy cost savings as the product of energy savings by fuel type and the corresponding price of fuel and then combined with secondary research on incremental material and labor capital costs to produce life-cycle economic metrics.
- Develop emissions benefits from energy savings as the product of energy savings by fuel type and the corresponding emissions factors.

ICF created baseline building energy models (developed from the Department of Energy's commercial prototypical building models) for the Medium Office, Hospital, Primary School, and Warehouse building types, in three primary and seven sub-US climate zones. These selections represent nine US cities and use the 2004 building energy model.[15]

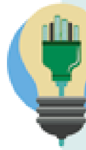
Next, ICF developed intervention models from the baseline building energy models representing the three-year solar reflectance and thermal emittance values commonly used in modeling for building-level code compliance.[16]

Intervention (I1): The black roof with code-compliant levels of insulation intervention is identical to the baseline condition but with roof insulation levels based on the ASHRAE Standard 90.1–2019 minimum rated *R*-value building enclosure criteria given in the prescriptive building envelope compliance path for conditioned nonresidential opaque roof (exterior) elements for insulation entirely above deck.

Intervention (I2): The cool roof with baseline levels of insulation intervention is identical to the baseline condition but with three-year-aged solar reflectance and thermal emittance values of the ASHRAE 90.1–2019 standard for cool (or white) roofs.

Intervention (I3): The cool roof with code-compliant levels of insulation intervention is identical to the black roof with code-compliant levels of insulation but with the three-year-aged solar reflectance and thermal emittance of the cool-roof intervention (I2).

With their intervention models in place, the researchers then performed energy use and economic benefit (i.e., energy-cost savings,



ROOF ALBEDO, INSULATION, & ENERGY EFFICIENCY

1. Black roof with code-compliant insulation.
2. Cool roof with baseline insulation.
3. Cool roof with code-compliant insulation.

incremental material and labor costs) analyses on each of the intervention scenarios to determine which offered the greatest energy savings and economic benefit.[16]

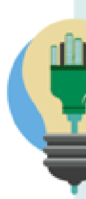
The results of these analyses were mixed, as the benefits offered by the three interventions were determined by the characteristics of the four building types.[15] As the study notes:

- Intervention 1 offered the greatest energy savings with buildings that had larger conditioned floor areas and space heating and cooling requirements and was cost-effective for almost all building types and climate zones.
- Intervention 2 offered less than 2% energy savings (the impacts of cool roofs alone, if and when they were positive, were small) and was cost-effective in some scenarios, but the lifetime net benefits were small compared with those offered by increased insulation.
- Intervention 3 offered the greatest energy savings with larger conditioned floor areas and space heating and cooling requirements and was cost-effective in some building types and climate zones.

The study comparing code-compliant roof insulation and roof albedo concluded the following:

- Code-compliant insulation provides greater net benefits than the cool-roof intervention in all cases.
- Insulation levels are equally as or more effective than "cool roofs" in achieving energy-saving goals.
- Cool roofs tend to provide only a marginal or slight reduction in energy use across all modeled climate zones when installed with traditional levels of insulation. These findings applied to most commercial building types with low-sloped roofs and insulation installed entirely above deck.

The findings suggest code-compliant insulation in most cases provides significantly



ROOF ALBEDO, INSULATION, & ENERGY EFFICIENCY

In all cases code-compliant insulation yields greater net benefits than cool roofs.

Insulation is as (or more) effective than a cool roof for energy savings.

greater net benefits than cool-roof intervention in all but a few rare cases where the insulation intervention is not cost-effective. And despite a modest reduction in cool-roof impacts when combined with code-compliant insulation, the combination of code-compliant insulation and a cool roof provides greater benefits than either alone. This finding suggests that when there is an equal opportunity to either increase the roof insulation to be code-compliant or pursue a cool-roof project, one would be remiss to not elect the insulation intervention, after which the incremental economics of installing a cool roof tend to be lessened.[16]

STUDY LIMITATIONS AND AREAS FOR IMPROVEMENT

The researchers noted challenges and limitations that impacted their findings. For example, in phase 1 of the ICF study "Assessing the Effects of Local Cool Roof Policies on Urban Heat Islands,"[12] researchers noted that, although the study met the objective of developing a replicable and scalable framework to assess the relative role of commercial cool roofs on local urban heat islands, these results were influenced by limitations, including control of confounding environmental factors, spatial separation between urban areas, and low correlations between weather station air temperature and urban density.[8]

Further, weather station air temperature and urban density are the two variables used to determine UHI intensity over the analysis period. The lack of correlation between these two variables has several implications.

- First, it suggests air temperatures recorded at weather stations are influenced primarily by local conditions and to a lesser degree (or if at all) by the nearby surrounding areas.
- Second, it implies that urban density alone is not a good proxy for air temperature as anthropogenic and environmental factors, such as tailpipe emissions and the color of impervious surfaces, also influence temperature.
- Third, it implies that the margin of error in the temporal UHI intensity analysis is significant in most cases to negate trends observed in UHI over the analysis period.

Limitations pertaining to the quality and coverage of satellite imagery also contributed to inconclusive results.

- Satellite data was limited to 30-meter resolution and provided less granularity for classifying imagery, discerning between objects, and distinguishing between land surface colors than higher-resolution (0.5- and 1.0-meter resolution) data.

- The geographical boundary assessed for changes in land surface color includes cool roofs as well as other land-use changes, such as an increase in landscape vegetation and possible increased urban tree canopy. Both options are well known and effective strategies for UHI mitigation.
- The lack of trends directly relatable to cool roofs can be attributed to the geographical area of coverage and satellite resolution and could be a result of differences in cloud cover between selected satellite imagery, changes in urban land use other than from cool roofs, or loss of reflectivity or darkening of white surfaces (including roofs) due to surface degradation.

In phase 2, the study limitations were related to conclusions that can be drawn from the analysis results due to environmental factors rather than study design. These include the following:[9]

- **Control of confounding environmental factors**—Two aspects common to the referenced cities are the prevalence of local ordinances and double-digit population growth, both of which have potentially interactive and/ or confounding, but opposite impacts with UHIs. Vegetative roof mandates and tree planting, for example, are complementary UHI mitigation strategies to cool-roofing ordinances. While the impacts of complementary UHI policies may moderate the impacts of population growth, after city selection, the best course of action to reduce potential bias is to select analysis periods that both cover significant installations of cool roofs and limit the change in environmental conditions from related UHI policies.
- **Representative weather stations**—While there is a sufficient quantity of available weather stations, the analysis is limited both by the geographic availability of those used in the CCCSP, which consisted of those generally to the south that are in nonmountainous areas; the number of weather stations used in the Climate Central study, which is limited to one urban and three rural stations; and location of the weather stations. While the airport station has a high urban density, it is located close to a body of water (river) that may exert influence over the air temperature in a way that counters the analysis.

RECOMMENDATIONS FOR FUTURE RESEARCH

As part of their studies, the researchers identified issues in which further study could increase understanding of the benefits cool roofs might have on UHIs and energy efficiency. They include the following:[9]

- Comparing cool roofs with other strategies for reducing the creation and impacts of UHIs, such as increasing vegetation area and improving the albedo of paved surfaces. Both of these approaches have been shown to reduce the effects of UHIs beyond that of low-albedo commercial roofs.
- Assessing the strength and significance of daytime UHIs for the top 10 US cities following the methodologies outlined in the CCCSP study. For each analyzed city, researchers should assess the magnitude and timing of impact from other environmental factors that influence UHIs over the analysis period.
- Using high-resolution GIS data to evaluate building-level changes in white roofs as well as changes in landscape vegetation, as both may influence the creation and impacts of UHIs.
- Analyzing the variability of air temperatures over time in cities where the majority of roofs are white to see if it has a positive impact on the occurrence of UHIs.

POLICY IMPLICATIONS AND CONCLUSION

The decisions by cities and building code governing bodies to mandate reflective roofing in certain climate zones have preempted the economic and science-based individualized design decisions predicated upon critical factors such as local geography, building use, or the roofing materials' carbon footprint. Focusing on the reflectivity of roofing materials as a means of addressing the impacts of UHIs is misplaced and unproven.[15]

Therefore, the ERA recommends that federal, state, and municipal governments refrain from mandating policies that require reflective-roofing mandates until the presumed benefits of cool roofs are compared with other strategies for increasing energy efficiency and reducing the effects of UHIs. Further, these comparisons must use consistent and robust methodologies for evaluating other strategies known to mitigate UHI impacts, such as increasing landscape vegetation and improving the albedo of paved surfaces, both of which account for many times the total area of low-albedo commercial roofs.[4]

Meeting these requests would result in the broader, more rigorous, and consistent real-world analysis needed to assess the value of cool-roof mandates within a larger, more comprehensive plan for addressing the impacts of climate change.

The strategies for reducing the impact of UHIs and boosting energy efficiency vary widely and the impacts of cool roofs compared with other approaches, such as installing cool pavement, increasing landscape vegetation and tree planting, and implementing smart growth policies and regulation, have not been determined.

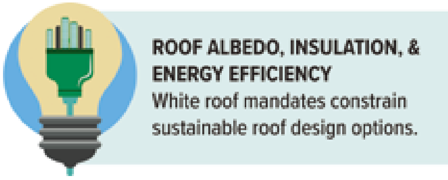
The Clemson University review of current literature on cool roofs found questions that need to be examined in depth to understand the benefits and implications of cool roofs: How does seasonality impact UHI and cool-roof efficacy? How do different locations, roof types, and climate zones impact UHIs and energy efficiency? Should cool-roof implementation focus on roofs with the largest surface area? To what degree does material degradation impact the effectiveness of cool roofs? And what are the economic and life cycle benefits of cool roofs?[5]

Further, although there is an abundance of current research that examines the impact of cool roofs on building performance, energy efficiency, and UHIs, there are notable gaps and inconsistencies in their research methodologies that limit the application of their findings in real-world settings. These gaps and discrepancies are significant, for the effectiveness of cool roofs in addressing these issues depends on a combination of factors that are unique to each city and/or geographic location, and thus incongruous with one-size-fits-all roof mandates.[5]

Similar conclusions were reached in the three-phase ICF study "The Impact of Cool Roof Mandates on Urban Heat Islands,"[7] which found that commercial rooftops, including cool roofs, are only one of many factors impacting UHIs, and that the impact of cool-roof mandates on UHI is largely inconclusive and requires more research. This is important information for policymakers who may view cool roofs as a silver bullet they can use to defend citizens against the threats of climate change.[4,6]

Further, the ICF study "A Comparison of Code-Compliant Roof Insulation and Roof Albedo Impacts and Benefits"[15] reached a similar conclusion: there is a proper location and usage for every roof membrane available, and the use of cool roof does not yield the greatest benefits in all cases. As the ICF researchers note, "When there is an equal opportunity to either increase the roof insulation to be code-compliant or pursue a cool roof project, one would be remiss to not elect the insulation intervention, after which the incremental economics of installing a cool roof tend to be lessened."[16]

All too often, mandates like those some US cities have been enacting in regard to the use of cool roofs on all new construction and roof replacements limit the flexibility to consider other options by focusing too intently on one environmental attribute—in this case roof reflectivity—instead of taking a more comprehensive approach



and considering the overall sustainability and resilience of the system, the roof assembly. Such restrictions limit the ability of roofing design professionals to use their education and training to design, specify, or recommend a particular roof membrane, and thereby prohibit them from implementing the best and most sustainable solution for the situation at hand.

Because ERA members make a variety of roofing membranes of various colors that are used in countless geographic locations and building types around the country, ERA's members believe that the fundamental questions about cool roofs raised in this white paper be answered before additional mandates prohibiting building owners from using the roofing products of their choice are enacted.

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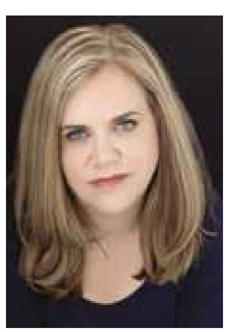

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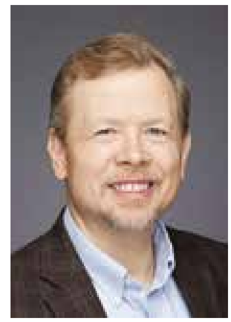
Ellen Thorp, *MA, CAE, is the executive director of the EPDM Roofing Association, whose members manufacture products for the roof and building enclosure. As the leader of the trade association, which has existed for over 20 years, she has served as a trusted advisor and a pivotal leader who has positioned the organization for growth and strengthened its goal of representing the manufacturers of EPDM single-ply roofing products and their leading suppliers. Thorp is an intentional collaborator who structures high-capacity coalitions to strengthen advocacy, outreach, and engagement initiatives for numerous organizations, regulatory agencies, and municipal governments. She has a bachelor's degree in political science and a master's degree in education policy and has earned the rigorous Certified Association Executive designation from the American Society of Association Executives.*



JASON P. WILEN, RRO, AIA, CDT

Jason P. Wilen, *RRO, AIA, CDT, is an architect and building enclosure specialist with over 30 years of experience. He joined Klein & Hoffman (K&H) in 2018 and is now an associate principal. Before K&H, Wilen served for 7 years as a director with the technical services section of the National Roofing Contractors Association and 18 years with architectural, forensic, and roof consulting firms. He holds a bachelor of architecture degree from the Illinois Institute of Technology, Chicago, and is a licensed architect in Illinois. Wilen provides leadership and project management for K&H's roof system and waterproofing rehabilitation projects; participates with enclosure commissioning efforts, provides litigation support, and consulting for building and energy code development. Additionally, he is a member of ASTM Committees D08, C16, and E60 and IIBEC, and he has authored over 25 feature articles for local and national trade journals and magazines. In 2022, he was awarded IIBEC's Richard M. Horowitz Award, honoring the best technical article published in its technical journal,* IIBEC Interface.

Please address reader comments to chamaker@iibec.org, including "Letter to Editor" in the subject line, or IIBEC, *IIBEC Interface*, 434 Fayetteville St., Suite 2400, Raleigh, NC 27601.