Rethinking Roofing Policy:
The Case for Performance-Based Standards Over Reflectivity Mandates

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A Technical Analysis for State Policy Leaders

As governments consider roofing regulations for energy efficiency and urban heat island mitigation, emerging research reveals significant limitations in prescriptive mandates—particularly in Climate Zones 4 and higher. This analysis examines scientific evidence supporting performance-based roofing policies that consider multiple sustainability factors rather than mandating highly reflective white roofs (HRWRs), often referred to as "cool roofs", as a single-attribute solution.

The Complexity Beyond Surface Reflectivity

Modern building science demonstrates that sustainable roofing requires evaluating multiple performance characteristics: energy efficiency, durability, moisture management, embodied carbon, recyclability, and climate-specific considerations. Early 2000s campaigns promoting newly developed plastic-based white roofs relied on oversimplified research methods and rudimentary climate modeling. While this research is still in use, it doesn't reflect current building standards or scientific understanding.

Municipalities have adopted HRWR mandates based on this preliminary research, with national model codes such as ASHRAE 90.1 and the IECC evaluating roof reflectivity as a single criterion, without accounting for other critical performance factors. This approach overlooks modern considerations like climate variation, energy efficiency, climate longevity, durability, maintenance, green infrastructure compatibility, embodied carbon, landfill impact, resilience, and comprehensive sustainability metrics.

Climate Zone Considerations

Energy efficiency codes developed with evidence-based, scientific input typically limit mandatory HRWR surfaces to ASHRAE Climate Zones 0-3 (Southern U.S.) and only where such roofs are over-cooled, conditioned spaces. This geographic limitation reflects the underlying complexity of roof system performance.

Modern codes require R-25 to R-35 roof insulation—three times more than the standards from 25 years ago, on which current 'cool roof' performance claims are still based. In ASHRAE Climate Zones 4 and higher (mid-U.S. and northward), increasing insulation provides greater energy benefits than reflectivity. Adding insulation to raise R-value from R-20 to R-30 can reduce annual energy use by more than 10 percent in Climate Zones 4 and north.

Limitations of Cool Roof Research

A comprehensive literature review conducted by the EPDM Roofing Association and Clemson University identified recurring flaws in cool roof studies published between 1985 and 2018. Although these studies provided valuable insights 25 years ago, their methodology no longer aligns with current building standards and codes, making them insufficient justifications for sweeping HRWR mandates across entire climate zones or cities. Common limitations of the research still cited today include:

Common limitations include:

- **Oversimplified or outdated modeling** that fails to represent in situ, real-world building conditions
- **Limited geographic scope** that ignores climate diversity across regions
- **Short-term monitoring** that overlooks seasonal and long-term performance effects
- **Low insulation baselines** that do not reflect the current code and artificially inflate the apparent value of reflectivity
- **Inconsistent measurement methodologies** for albedo and temperature assessment
- **Inadequate consideration** of winter heating penalties and moisture management

Recent and Emerging Urban Heat Island Research

Recent peer-reviewed studies have created a preponderance of evidence to challenge HRWR mandates and assumptions:

- **Harvard Study (Cheng & McColl, 2024):** Widespread HRWR adoption can increase surrounding temperatures, reduce precipitation, and worsen heat inequality between affluent and low-income neighborhoods.
- **Stanford Research (Jacobson & Ten Hoeve, 2011):** Large-scale cool roof deployment may cool ground-level temperatures locally but increases atmospheric stagnation, reduces cloudiness, and causes net global warming effects.
- **ICF Study (2023):** Found no clear correlation between HRWR mandates and urban heat island reduction in Climate Zones 3–5. Cities like Chicago and New York reported no measurable improvement after 15+ years of mandates.

Other Considerations

Moisture and Structural Issues

In Climate Zones 4 and north, HRWRs often require additional vapor retarders or air barriers to prevent condensation and moisture accumulation. Since codes don't frequently mandate these components, cost-conscious owners may opt out, creating assemblies that trap moisture and fail to dry in summer, potentially causing persistent dampness, reduced insulation performance, and mold growth.

Low-Reflective Roofs Offers Superior Performance Roofing

- **Proven Longevity:** EPDM and asphalt-based products demonstrate service lives of 40+ years, far exceeding the typical 15-20 year service life of a white plastic-based option that is flooding the marketplace. This longevity means fewer tear-offs, reduced landfill waste, and lower embodied carbon.
- **Recyclability:** Unlike many HRWR materials, EPDM and asphalt materials are durable and can be fully recycled into other materials, such as those used in roads, playground surfaces and park benches, which reduces disposal costs, landfill waste, and embodied carbon.
- **Durability:** Low-reflective roofing systems such as asphaltic BUR and MB and rubberized EPDM are inherently durable and can withstand extreme weather, significant temperature changes, and impacts, including hail, UV protection, and even the foot traffic of rooftop gardens.
- **Maintenance:** Straightforward, cost-effective repairs often extend roof life without replacement. Properly installed asphaltic and EPDM systems offer significantly lower maintenance costs—making them a preferred option for building owners.

Green/Vegetative Roof Infrastructure Compatibility

Research shows irrigated vegetative roofs are most effective for urban heat island mitigation (Tewari et al., 2019). EPDM, for example, provides an optimal foundation for vegetative roof installations, and the industry also supports urban tree canopy initiatives that align with EPDM. These are two strategies that deliver measurable benefits where reflective surfaces failed and make the biggest difference for urban heat island mitigation.

The structure for a ballasted roof often used in low-slope EPDM and asphaltic roofs also serves as an excellent platform for solar panel installations, enabling renewable energy goals while maintaining superior roof performance. The heat can impact solar panels reflected upward from HRWR plastic membranes, which can add up to nine degrees to the solar panel. Excessive heat of this type can impact photovoltaic efficiency, reducing the amount of energy collected.

Policy Recommendations

Rather than mandating single-attribute solutions, legislators should consider performance-based flexibility that allows architects, designers, and building owners to specify roof systems tailored to the comprehensive needs of the built environment and climate zone. This approach should:

1. Reject Universal Mandates: Avoid prescriptive requirements mandating specific roof colors without considering climate zone, building type, and performance factors.
2. Support Performance-Based Standards: Develop climate-specific codes that allow optimization across multiple sustainability criteria and research-based, proven strategies, rather than single-attribute decisions.
3. Require Climate-Specific Analysis: Ensure regulations account for regional climate zone variations and modern insulation standards.
4. Consider Full Lifecycle Impact and Whole Building Performance: Evaluate policies based on total environmental impact, including durability, embodied carbon, longevity, recyclability, maintenance and total lifecycle costs.
5. Prioritize Proven Strategies: Focus on demonstrated mitigation strategies like urban tree canopy rather than unproven reflectivity mandates.

Conclusion

Evidence increasingly supports a balanced, performance-based roofing policy. While HRWR benefits specific hot, dry climates, universal mandates overlook the complexity of building science, climate variation, and sustainable design principles. Evidence-based policy should embrace the complexity of building science and allow flexibility for optimal performance across diverse climatic and building conditions.

For Climate Zones 4 and higher, low reflective roof systems like asphaltic and EPDM offer superior durability, energy performance with proper insulation, lower lifecycle costs, full recyclability, and compatibility with proven sustainability strategies including green infrastructure and solar installations.

State legislators should prioritize flexible, science-based policies allowing building professionals to optimize roof design for local conditions and comprehensive sustainability goals rather than simplified mandates.

Single-attribute mandates, despite good intentions, may compromise energy efficiency, structural integrity, and environmental outcomes that comprehensive, performance-based approaches can better achieve.