BUILDINGENERGY BOSTON

Keeping it Cool! Toolkits and Strategies for Extreme Heat and Urban Heat Island Mitigation

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Northeast Sustainable Energy Association (NESEA) | March 23, 2026

Keeping it Cool! Toolkits Strategies for extreme heat and Urban Heat Island Mitigation

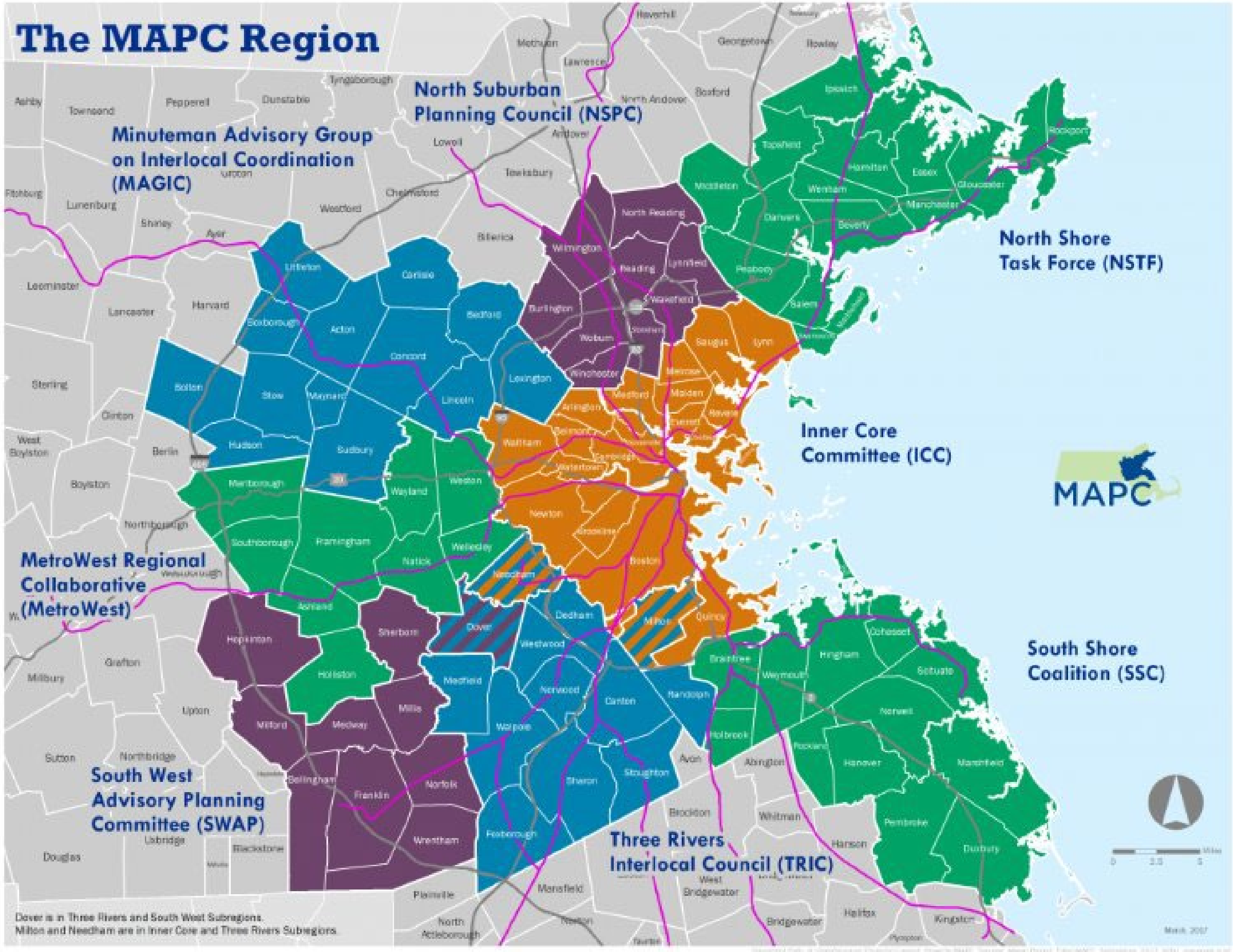
BuildingEnergy Boston 2026

March 23, 2026

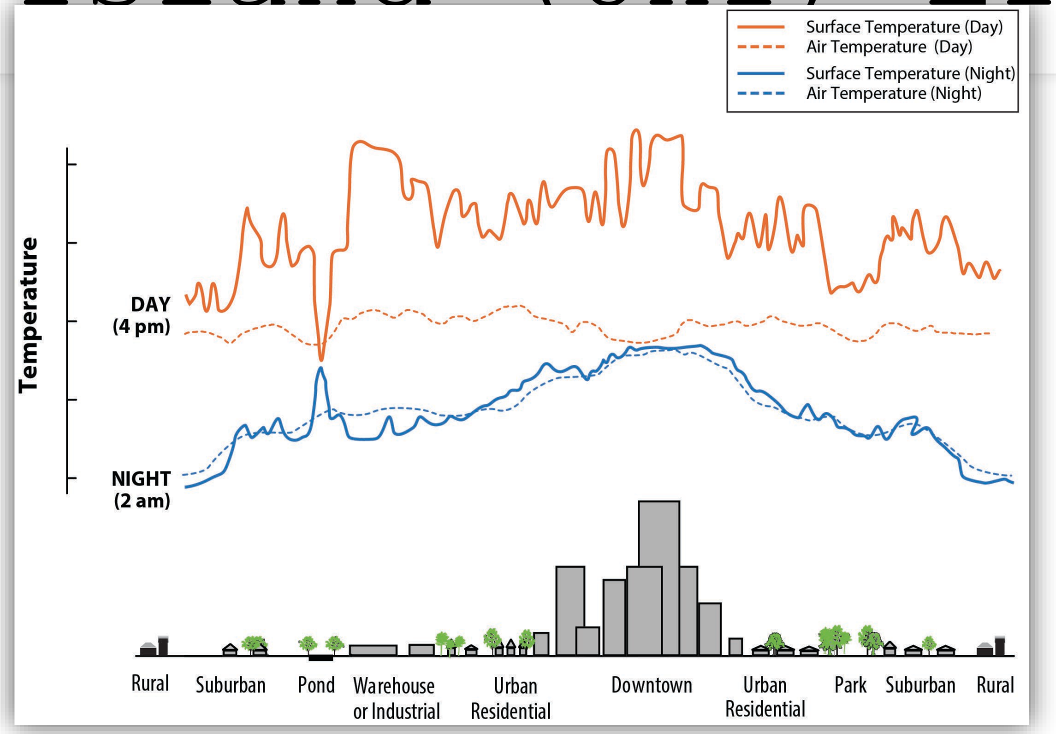
1:00 PM – 2:00 PM

The Metropolitan Area Planning Council (MAPC) is the regional planning agency for the 101 cities and towns of Greater Boston.

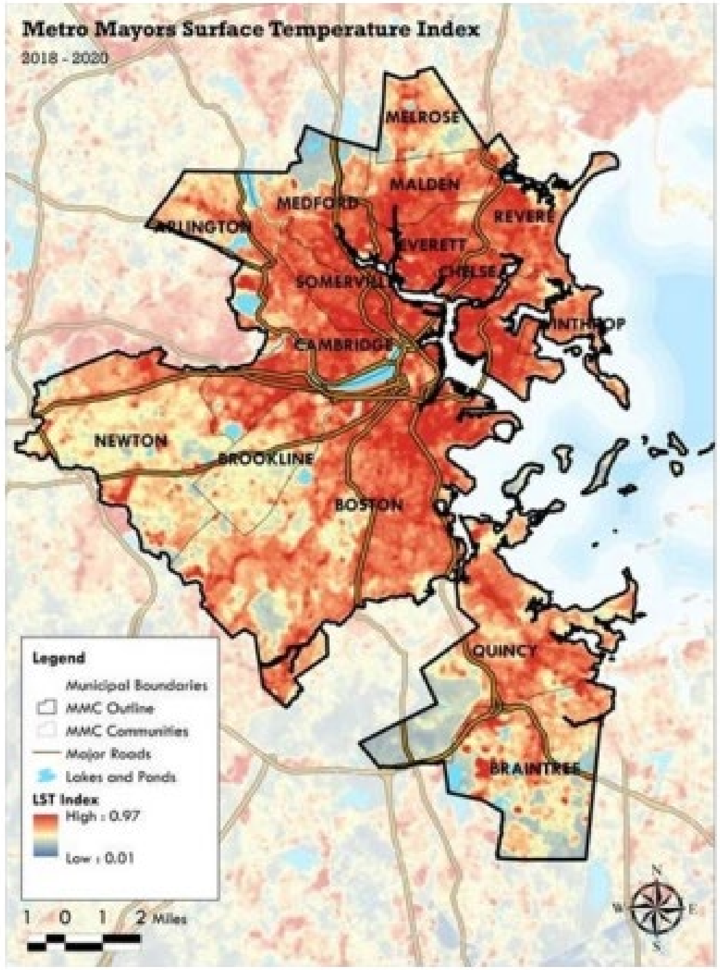
We work to create a more sustainable, equitable, collaborative, and climate-resilient



Extreme Heat: Urban Heat Island (UHI) Effect



Source: US EPA [Reducing Urban Heat Islands: Compendium of Strategies - Urban Heat Island Basics]



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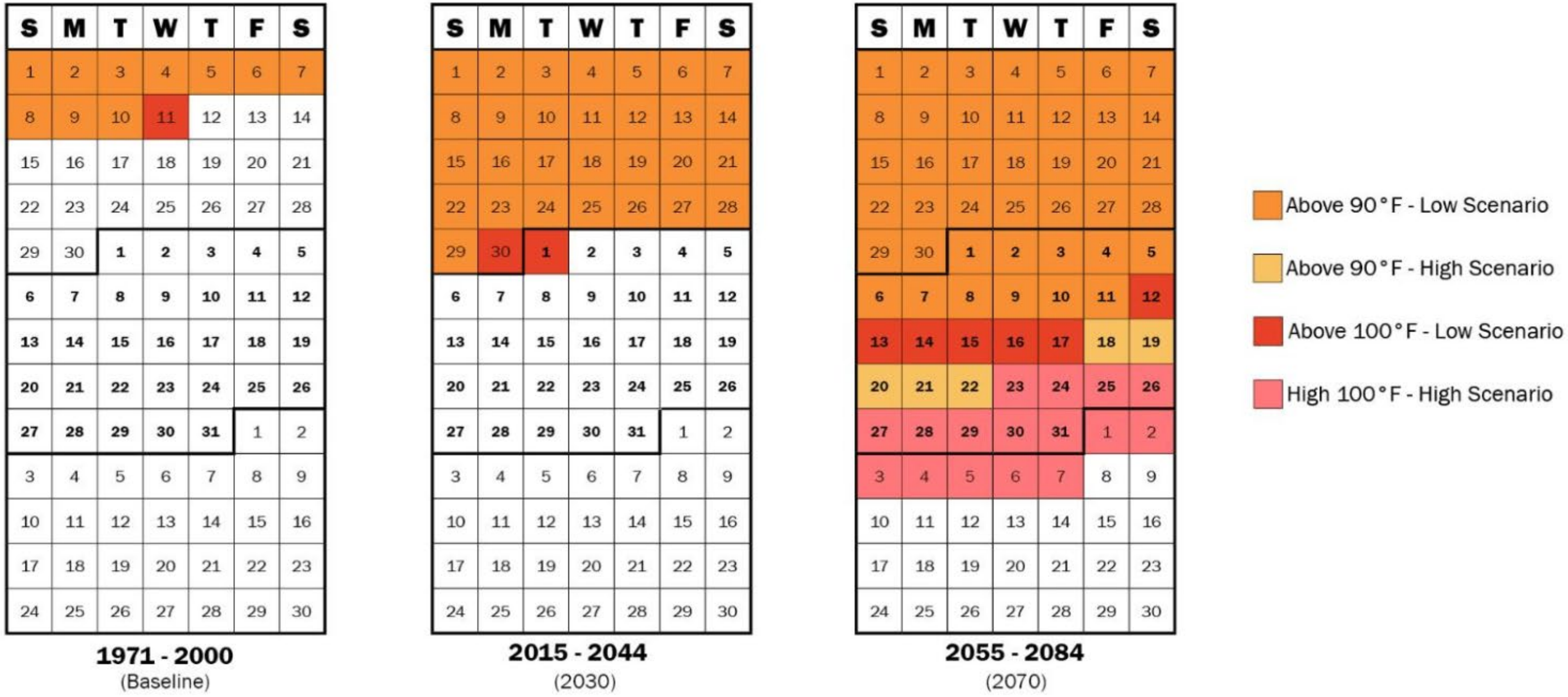
Extreme Heat: A Growing Threat to MA

Source: City of Cambridge "Heat Risk" Resilient Cambridge Report



By the 2030s, average summer heat index in the City can be around 95°F, and by the 2070s, average summer heat index can be as high as 110°F.

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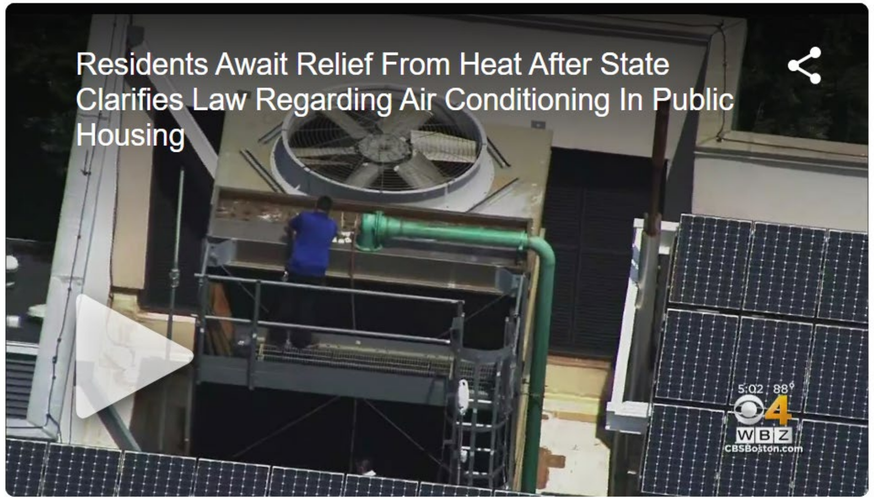
Why are we vulnerabl

Aging infrastructure and old housing stock not built for prolonged heat

Lack of policies and standards protecting people from extreme heat

Residents are less culturally / behaviorally adapted to extreme heat

Public health threat- increase heat-related illnesses and exacerbate existing health



WEATHER

Record-high temperatures leave thousands of Mass. customers without power

Tuesday marked the peak of a recent heat wave in the Northeast, leaving nearly 14,000 customers without power.

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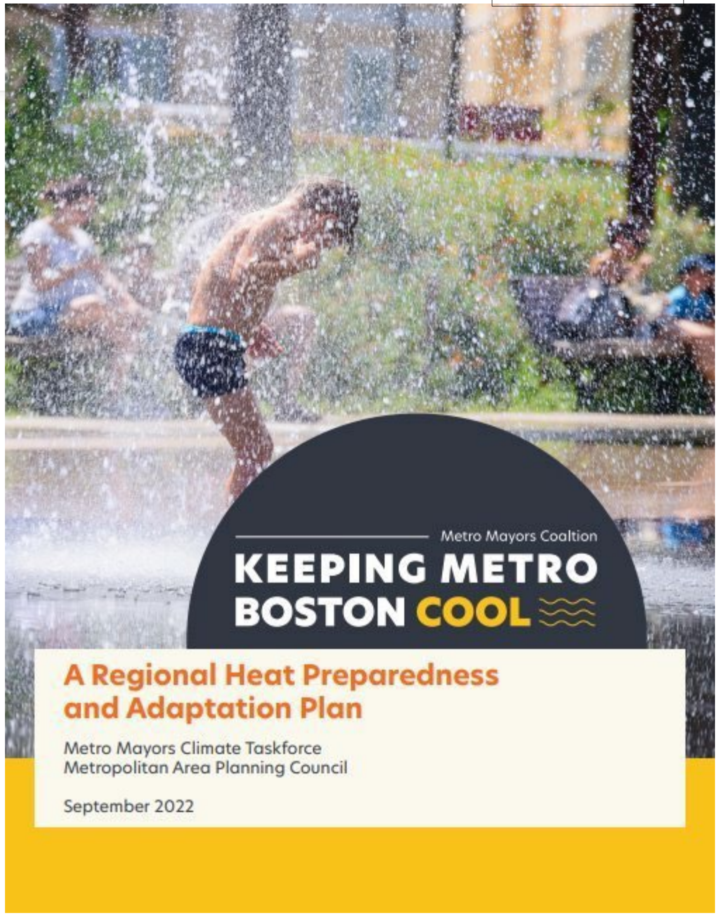
Support for Communities

Data & community centered planning

Coalition building, policy, & advocacy

Implementation & technical assistance for solutions

Data & Community Centered Planning



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Coalition Building, Policy & Advocacy

- Resilient Land Use Toolkit - examples for local zoning across a variety of climate impacts
- Healthy Environments Advance Learning – policies and procedures for addressing heat in schools
- Research and advocacy for local and state policies

FOSTERING COLLABORATIONS

A Symposium to Advance Equitable Heat Health Actions

MAPC   BU School of Public Health Center for Climate & Health   HARIRI INSTITUTE

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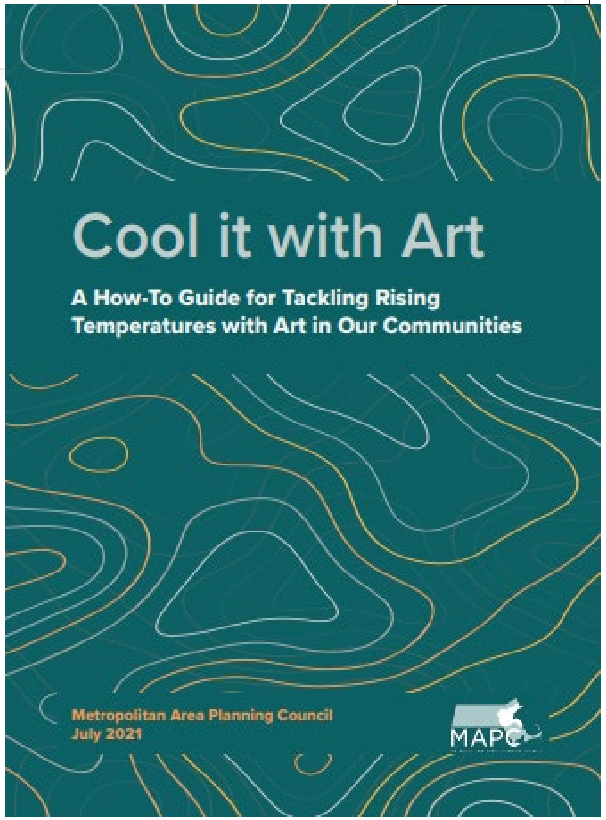
Implementation Resources for Extreme Heat

- Cool Roof Site Suitability Tools
- Resilience Playbook
- Cool Communications and Social Media Toolkits
  - Social Media Toolkit
- Cool it with Art guidebook



The Smart Surfaces Coalition is made up of more than 50 leading national and international organizations with a shared commitment to creating **cooler**, **healthier**, and **more resilient** cities by cost-effectively reducing the impacts of extreme urban heat and flooding.

What are Smart Surfaces?

Infrastructure strategies that cost-effectively manage urban heat and stormwater while maximizing health, climate, and equity co-benefits

Reflective/Cool Roofs

Green Roofs

Porous & Permeable Pavements

Solar Photovoltaics

Reflective/Cool Pavements

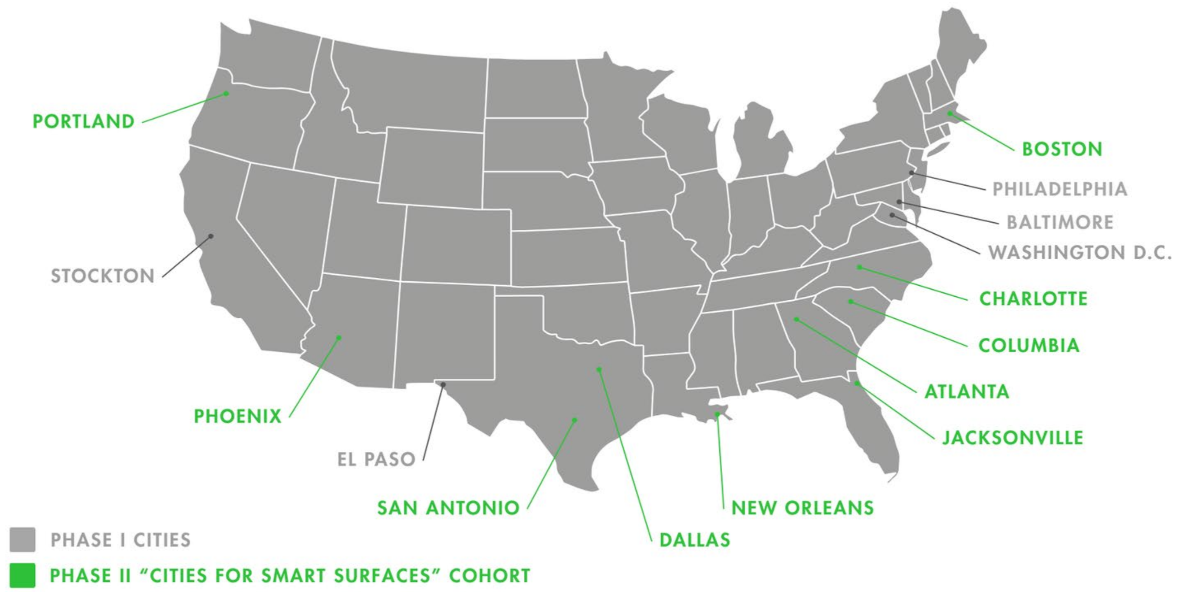
Trees

Green Stormwater Infrastructure

Zero & Negative-Carbon Concrete

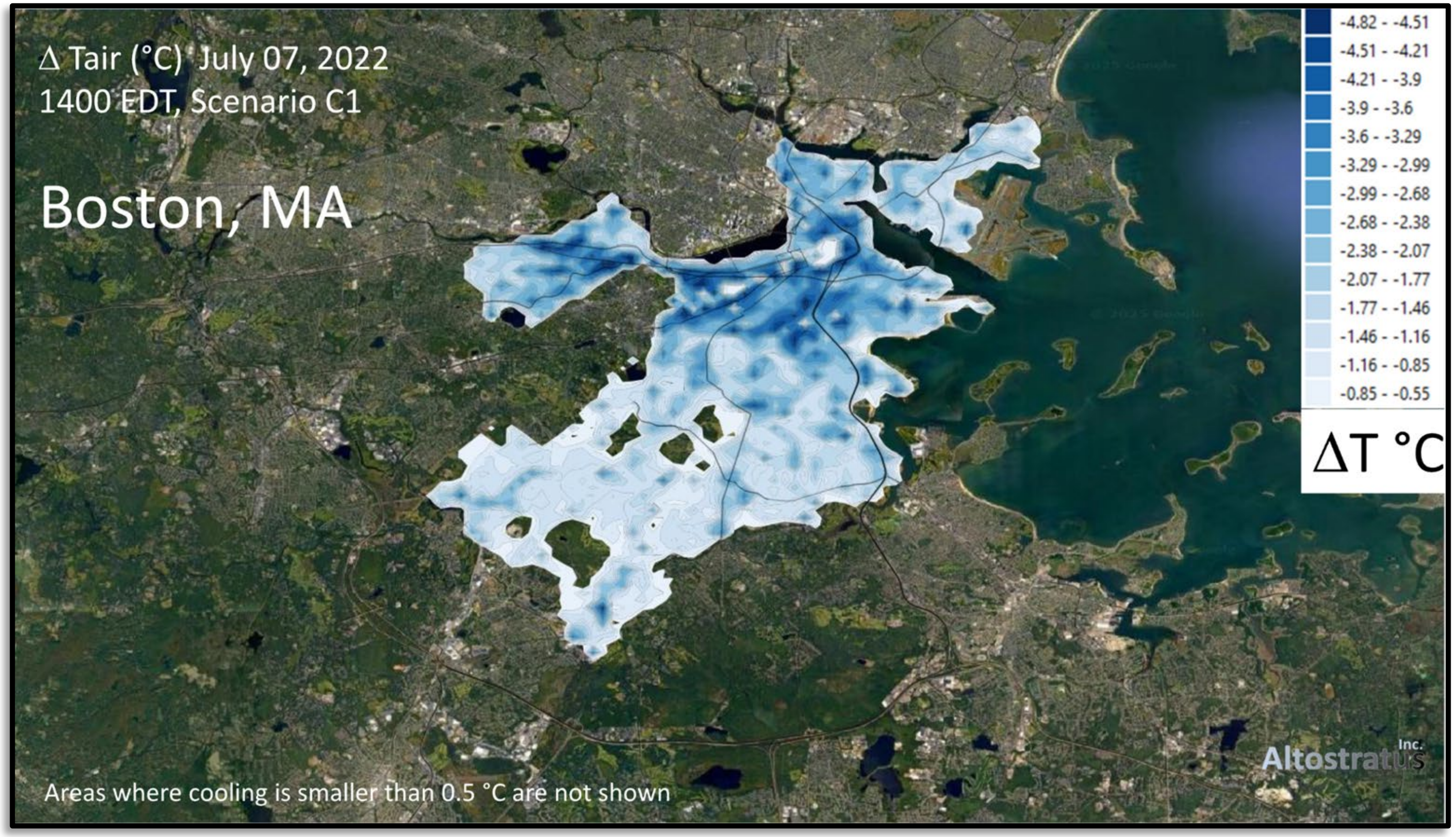
Cities for Smart Surfaces Program

SSC is partnering with 10 metro areas across the US to facilitate the adoption of Smart Surfaces at the metropolitan level and working with communities in those regions to support community-led, local Smart Surface implementation projects.



SMART SURFACES COALITION

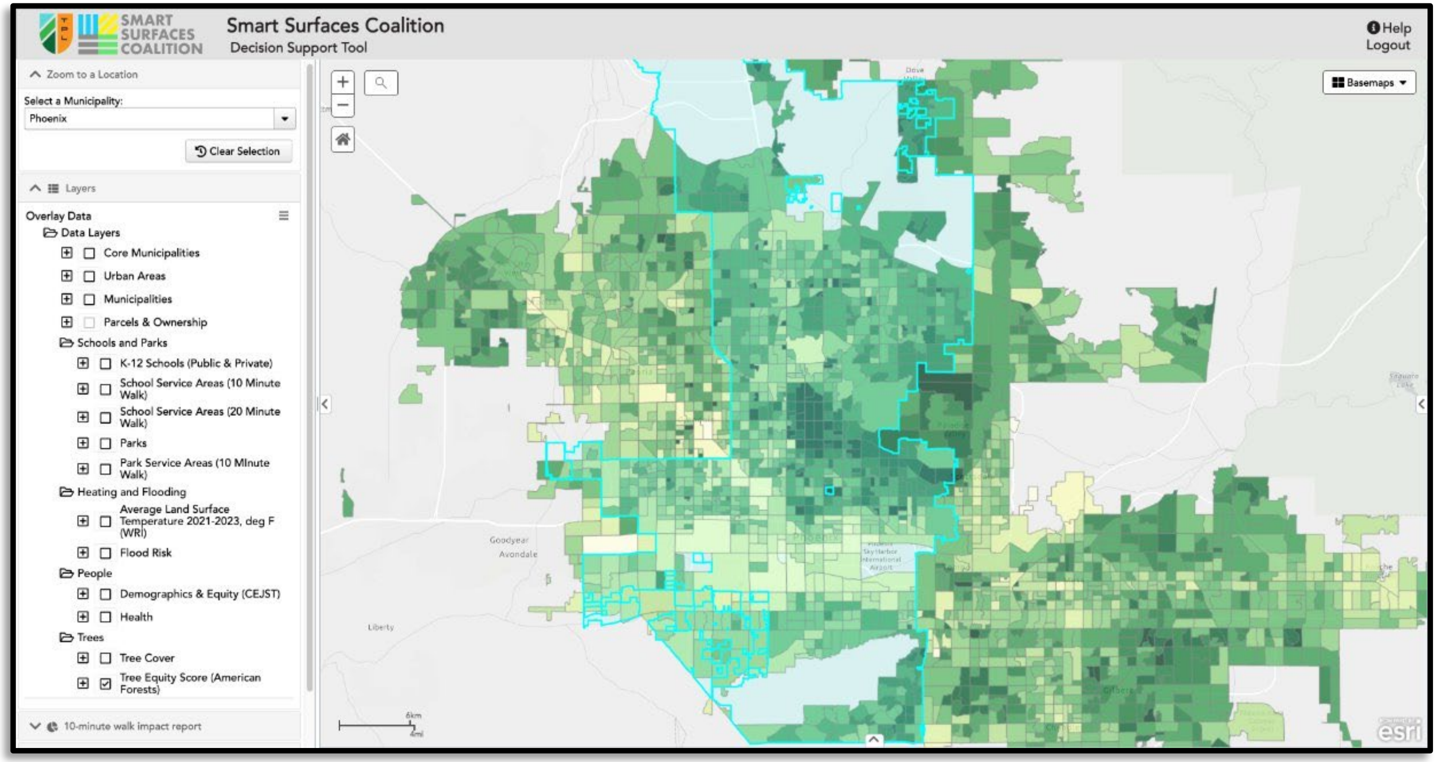
Micrometeorological Modeling



- Establishes baseline air temperatures
- Models air temperature reductions as a result of:
  - Cool roofs
  - Cool pavement
  - Urban trees
- Used for benefit-cost modeling in policy and planning tools

SMART SURFACES COALITION

Decision Support Tool



Supports:

- Communication/education between city staff, policy makers, and public
- Development of city plans, policies, and grant applications
- Project and site prioritization

Benefit-Cost Analysis Tool

Includes:

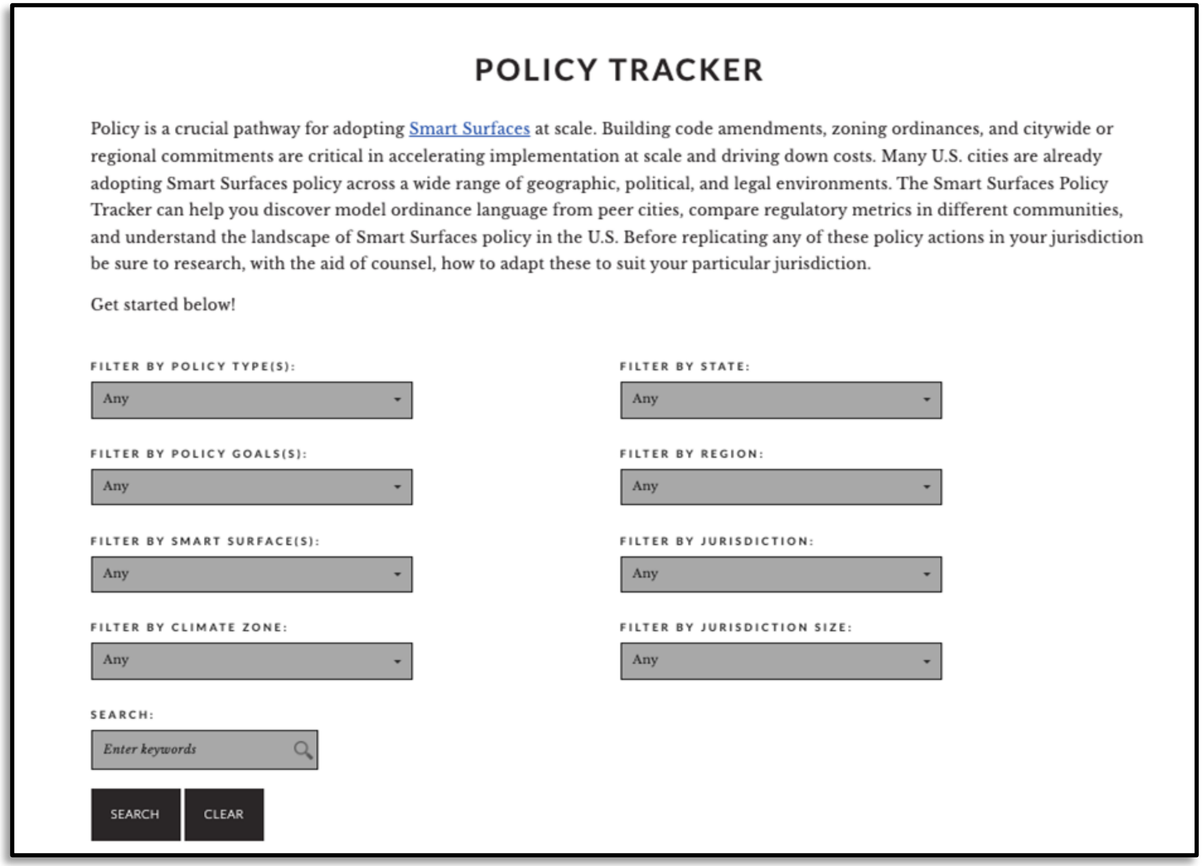
- $$, °F, and CO2e impact through 2030, 2040, and 2050
- Benefits from infrastructure, energy, health, and environmental sectors

Allows municipalities to:

- Model impacts of policy changes and city- and neighborhood-scale infrastructure projects
- Communicate to public, city staff, policy makers, and City Manager/Mayor
- Generate metrics for city plans and federal and state grant applications

SMART SURFACES COALITION

Smart Surfaces Policy Tracker



POLICY TRACKER

Policy is a crucial pathway for adopting Smart Surfaces at scale. Building code amendments, zoning ordinances, and citywide or regional commitments are critical in accelerating implementation at scale and driving down costs. Many U.S. cities are already adopting Smart Surfaces policy across a wide range of geographic, political, and legal environments. The Smart Surfaces Policy Tracker can help you discover model ordinance language from peer cities, compare regulatory metrics in different communities, and understand the landscape of Smart Surfaces policy in the U.S. Before replicating any of these policy actions in your jurisdiction be sure to research, with the aid of counsel, how to adapt these to suit your particular jurisdiction.

Get started below!

FILTER BY POLICY TYPE(S): Any

FILTER BY POLICY GOALS(S): Any

FILTER BY SMART SURFACE(S): Any

FILTER BY CLIMATE ZONE: Any

FILTER BY STATE: Any

FILTER BY REGION: Any

FILTER BY JURISDICTION: Any

FILTER BY JURISDICTION SIZE: Any

SEARCH: Enter keywords

SEARCH CLEAR

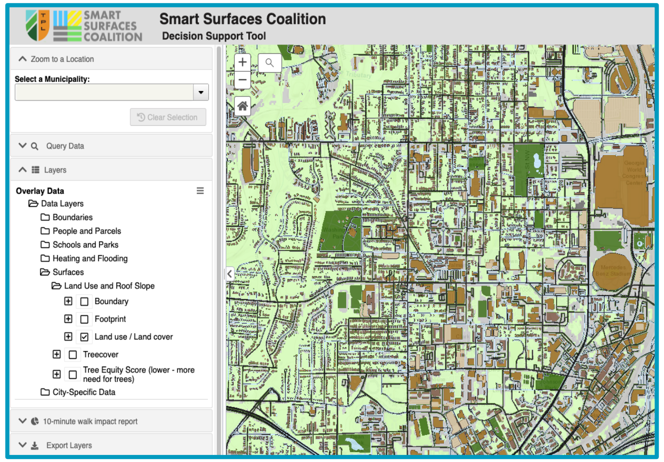
Allows policymakers to:

- Search for policies by Smart Surface technology, jurisdiction size/location, climate zone, etc.
- Identify/compare policy language from peer cities
- Review 2,000+ policies to date
- Explore expert guidance about:
  - *Green stormwater infrastructure*
  - *Tree canopy*
  - *Cool roofs*
  - *Permeable pavement*
  - *Cool pavement*

SMART SURFACES COALITION

Three New SSC Tools for Citywide Transformation

Decision Support Tool



Provides cities with highly detailed characterization of albedo, porosity, surface and ambient temperatures, along with census-tract level population health and equity data.

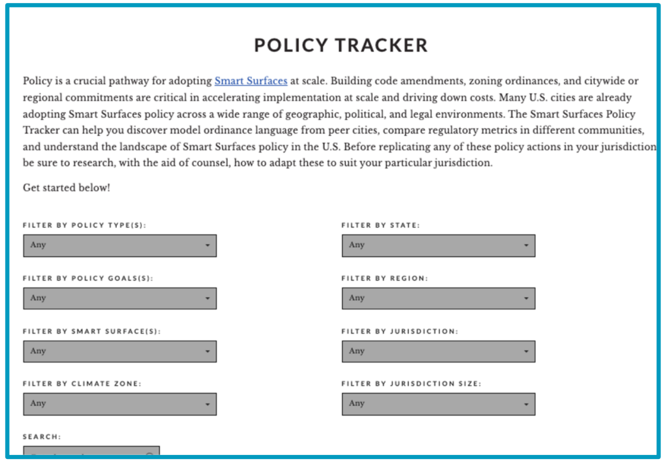
[Watch DST Demo]

Benefit-Cost Analysis Tool

Enables cities to model the financial, health, environmental, and energy impacts of Smart Surface infrastructure interventions using at the census tract, city, and metro area levels.

[Watch BCAT Demo]

Smart Surfaces Policy Tracker

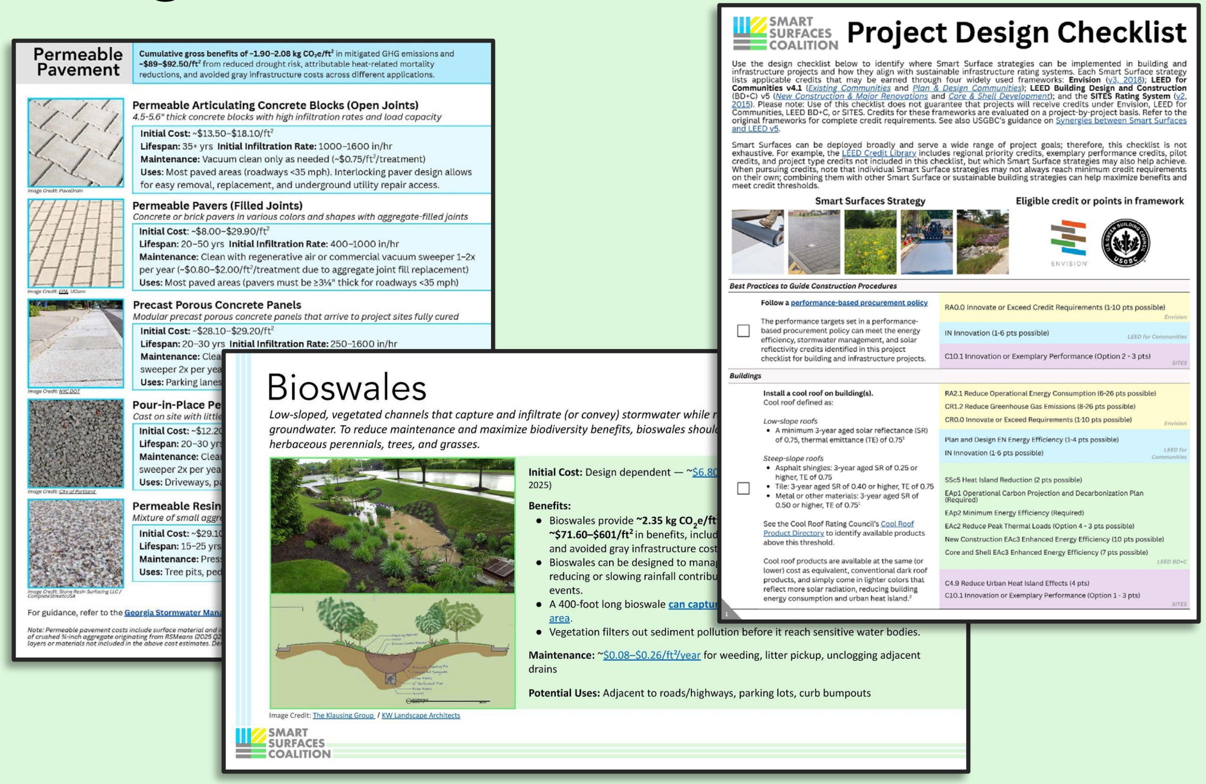


Enables cities to search from 2,000 Smart Surfaces policies and codes from all states to craft policies. SSC also developed model policy language to enable citywide adoption.

[Visit SSPT Site]

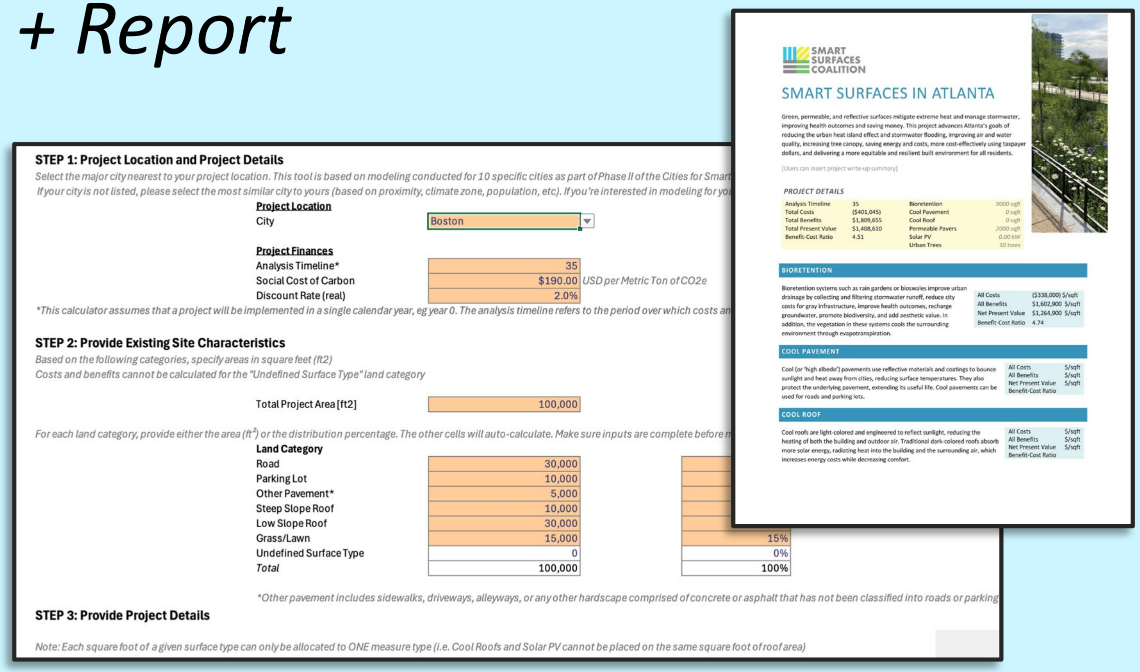
Project Implementation Platform

Design Resources



- ➢ *Cost and benefit data*
- ➢ *Performance specifications*
- ➢ *Case studies*
- ➢ *Design recommendations*

Benefit-Cost Analysis Calculator + Report



- ➢ *Quantified costs and benefits of Smart Surface strategies across infrastructure, energy, health, and environmental sectors*
- ➢ *Pre-formatted project report*

SMART SURFACES COALITION

Smart Surfaces Peer Learning Network

- Connects staff across cities and agencies to share strategies for urban climate resilience
- Regular Zoom meetings highlight city-led case studies and implementation lessons
- Access to SSC's Policy Help Desk for policy guidance and technical support
- Engagement with researchers on performance measurements and best practices

Smart Surfaces Peer Learning Network Webpage

Photo Source: *Shutterstock*

nbi new buildings institute

Urban Heat Island Mitigation Toolkit

Design strategies, policy implementation approaches, and **product recommendations** for jointly considering UHI mitigation strategies with **other climate hazards and priorities.**

Covers:
Wildfire
Cold-Climate Considerations
Embodied Carbon

Intended for:
Policymakers
City planners
AEC community
Product specifiers

UHI and Wildfire Mitigation Strategies

Photo Source: *Shutterstock*

The Issue

- **Replacing natural landscapes with buildings** and impermeable surfaces raises urban temperatures.
- **Wildfires** are becoming more frequent and intense due to **rising temperatures and prolonged drought** conditions.
- Cities exposed to both extreme heat and wildfire risk face **conflicting demands:** many wildfire-resilient strategies can worsen the UHI effect.
- **The need:** Recommendations for how to implement strategies that **reduce the hazards of wildfire** while **avoiding exacerbation of UHI**.

Recommendations for UHI Mitigation in Fire-Prone Areas

Cooling Strategy	Area Fire Risk Level (Max.)	Wildfire Considerations	Sample Policy Approaches
Mapping and planning	Citywide	**Distinguish levels of risk** across the city and implement solutions accordingly.	• Zoning and overlays • Heat and hazard mapping
High-albedo surfaces (pavements and roofs)	High	Light and reflective surfaces reduce the amount of heat absorbed and are suitable strategies for areas with high fire risk: **no added fire fuel.**	• Zoning and overlays • Jurisdictional ordinances • Municipal programs
Urban forests and landscaping	High	Publish standards and guidelines that specify **species selection, spacing, pruning, and fuel-load management** to avoid increasing fire risk. Institute **fire-resistant vegetation and fuel-reduction techniques**, such as prescribed burns and removal of fire fuels.	• Climate Plans and Urban Heat Island Mitigation Plans • Wildfire-resilient landscape guidelines • Municipal ordinances • Landscaping initiatives
	Low	Institute **continuous vegetation area** to contribute to citywide cooling.	
Site design and landscaping	High	Create **30-100 ft defensible space** (depending on hazard level) from building and institute distinct strategies based on proximity to building. **Trees with min. 10' spacing** from structure and each other. Populate with **cool pavements, shade structures, low-fuel plants.**	• Zoning codes • Building codes • Wildfire-resilient landscape guidelines
	Medium	Trees with min. 10' spacing. **Ground cover permitted** but may not form means of transmitting fire to structure.	
Building envelope design	High	Adhere to **Wildland Urban Interface (WUI) Code** or equivalent.	• Building and Green Codes • Zoning Codes • Weatherization Programs
	High	**High-albedo building materials i**ncluding walls and facades reduce heat without vegetation-related fire risk. Use non-vegetative shade structures near buildings.	
	Medium	Fire risk for green roofs and green walls **depends on plant/species selection, maintenance, and irrigation**	

Strategy Deep Dive: Evaluation of WUI Code Provisions

WUI Code Parameter	Notes on UHI Tradeoffs
Ignition-resistant and noncombustible exterior materials (Sections 503.2, 504.5)	• Light-colored, non-combustible materials **reduce heat absorption and do not add fire risk.** • If not lightly colored, darker materials can increase heat. **To avoid, specify high-albedo cladding.**
Class A roof coverings (highest fire resistance) (Section 504.2)	• Cool roofs often meet Class A requirements, but may not always meet wildfire performance standards if they are combustible or prone to ember intrusion. Some fire-rated shingles have low reflectance. • **Specify cool-roof-rated Class A assemblies.**
Tempered, multilayered glazing (Section 504.8)	• Better insulation can reduce cooling loads. • **Pair with noncombustible shading devices if glazing is anticipated to increase solar heat gain.**
Noncombustible decks and projections (Section 504.7)	• Light-colored ignition-resistant decking can reduce heat. • Metal or concrete decking can be **specified with high reflectance.**
Protected eaves, soffits, fascia (Section 504.3)	• Insulated assemblies **can reduce heat gain.** • Conflict: **Cross-ventilation strategies improve thermal comfort** and can relieve heat in drier climates but can also **allow smoke or embers to enter.**
Fire-resistant landscaping (Sections 603, 604)	• Low-fuel plants can **provide cooling**, but limited canopy (widely-spaced) can **reduce shade.** • Ground cover permitted in defensible space and **can reduce UHI.** • Trees are permitted in defensible space but must be spaced **10' apart and away from structure.** • Characteristics of fire-resistive vegetation provided in Appendix F.
Defensible space (0-30 ft) and structure separation/spacing (Sections 503.1, 603, 604)	• **More hardscape can worsen UHI.** Removing vegetation reduces natural cooling. • **Populate with cool pavements, shade structures, low-fuel plants.**

UHI Mitigation Strategies in Cold Climates

Photo Source: *Shutterstock*

The Issue

- The UHI effect is not limited to cities located in warm climates: **UHI has been observed in almost all urban areas, including in colder climates.**
- Colder climate cities can still overheat especially during the summer months.
- Many cities located in cool and cold climates are **already planning or and implementing UHI mitigation strategies**.
- **The need:** Recommendations for how to implement strategies to **mitigate UHI in the summer** while **remaining mindful of these strategies' winter-time implications.**

Photo Source: *The Inquirer*

Overview of Recommendations

Cooling Strategy	Cold Climate Considerations	Sample Policy Approaches
Green Infrastructure	Covers a **broad range of infrastructure and landscaping strategies** employed to **capture water, mitigate flood risk, and reduce UHI** offer storm inundation mitigation benefits as well as summer cooling benefits.	• Impervious Coverage Limits • Street Design Standards • Zoning Standards and Guidelines
Trees and greening	**Native species** can tolerate a city's unique climatic conditions. **Deciduous trees** can offer significant passive energy benefits by providing shade in the summer and allowing for solar gain in the winter.	• Climate Plans and Urban Heat Island Mitigation Plans • Municipal Ordinances • Heat Island Reduction Codes • Tree Canopy Minimums
Pavements	**Pervious and reflective** pavements reduce heat absorbed by sun-facing surfaces. Cool **infrastructure must also be able to withstand winter conditions.**	• Permeable Paving Code • Reflective Surface Ordinance
Cool and green roofs	**"Winter heating penalty"** represents the risk that cool roofs can increase the need for heating and associated energy cost and demand in the winter. However, **generally, cool roofs offer net annual energy savings in cold climates; winter heating penalties are often limited. Green roofs also provide added insulation in wintertime.**	• Zoning Codes • Building and Green Codes • Economic Incentives
Building envelope design	**Passive design strategies** like reflectivity, insulation, air tightness are **useful in cold climates to control indoor environments from outdoor extreme weather events (cold and heat).**	• Building and Green Codes • Weatherization Programs • Economic Incentives

Strategy Deep Dive: Wintertime Penalties

Existing research on impacts of **high-albedo roofs:**

Wintertime heating penalties sometimes occur in colder-climate cities, but the **magnitude is often modest,** particularly when roofs are **well-insulated.** Penalties are usually **small compared to summer cooling savings.**

- **Annual net energy impact** is often small or still favorable to cool roofs, even in colder climates.
- Summer **cooling savings are substantial** for high-albedo roofs.
- **Snow cover moderates heating penalties**, already making the roof light-colored.
- Study in Greater Toronto Area showed potential **annual energy cost savings of more than $11 million for ratepayers.**

Existing research on impacts of **green roofs:**

- In cold climates, green roofs provide **additional insulation.**
- Green roofs reduce summer heat gains and **do not incur the same winter penalty profile** as highly reflective roofs: by contrast, their surface properties **change seasonally** and they **add thermal mass.**
- Most building-energy studies find **modest but generally positive annual energy impacts** in colder climates.
- Benefits for **top-floor comfort.**

Strategy Deep Dive: Pavement Performance Ratings

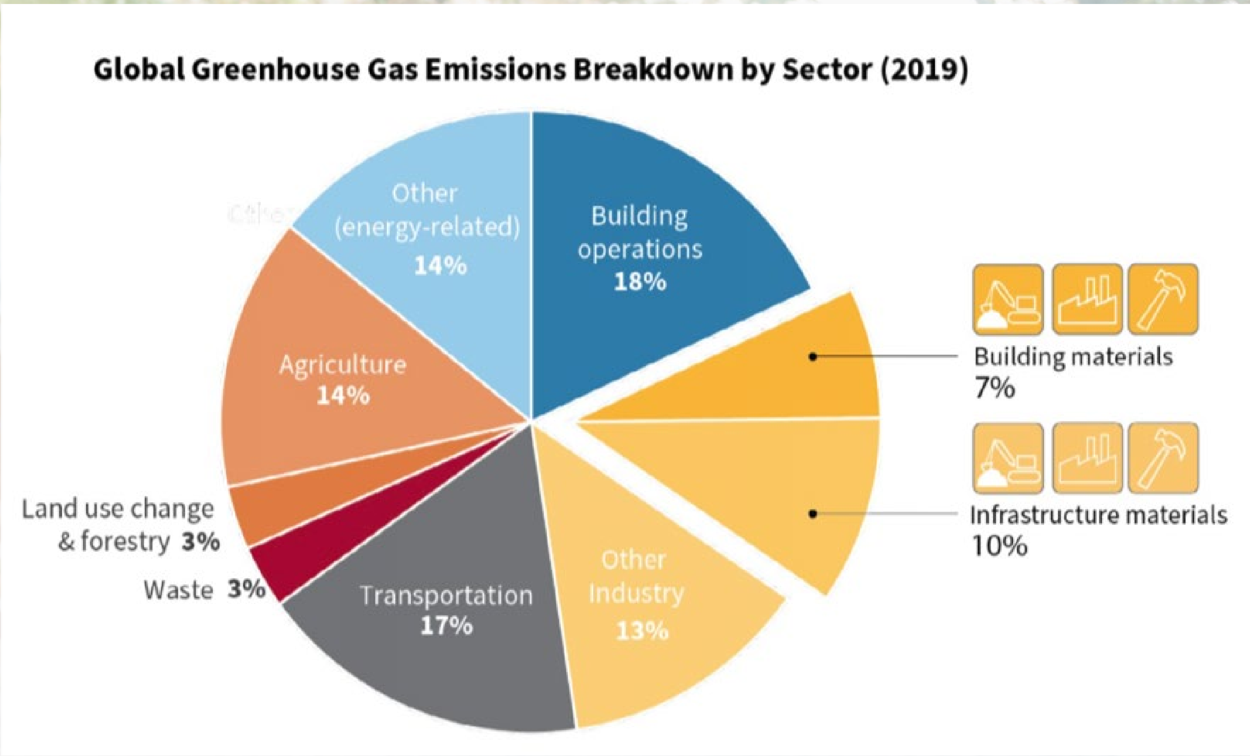
Product Type	UHI Performance	Cold Weather Performance
Reflective asphalt sealcoats	• Reflective coatings can **reduce surface temperatures** by up to 12°F. • Cooling effect can **improve performance of asphalt mixtures** in the field.	• Standard sealcoats reduce heat absorption and **hinder snowmelt** during winter. • Thermochromic coatings offer an option: change color based on ambient temperature.
Concrete additives	• Some additives (vermiculite, perlite, crushed glass) **reduce thermal** conductivity and daily temperature swings. • Reduces heat retention but **not as reflective as coatings or light-colored pavements.**	• **Durable** in cold climates. • Can handle **freeze-thaw cycles and plowing.** • Additive improve **resilience, longevity, and thermal stability.** • **Phase-change materials (PCMs)** can stabilize surface temperatures through the year.
Unit concrete or brick pavers (non-permeable)	• Non-permeable surfaces **store heat.** • **Modest reflectivity gains**. Light-colored options slightly reduce surface temperatures compared to conventional asphalt.	• **Durable** in cold climates. • Can handle **freeze-thaw cycles and plowing.**
Permeable interlocking concrete pavers	• Combined **reflectivity and permeability.** • Light-colored PCIPs can increase reflectivity. • Infiltration reduces surface heat.	• When over an open-grade base**, good resistance to frost heave and cracking.** • Joint openings **allow ice expansion and melt.**
Grass pavers	• **Absorb less heat** than conventional paving like asphalt and concrete. • **Evapotranspiration** cools surfaces. • Must be **maintained and irrigated.**	• Can **tolerate freeze-thaw cycles with proper drainage.** • **De-icing salts should be limited** to protect vegetation.
Gravel-filled plastic grid pavers	• Gravel surfaces **store less heat than asphalt.** • **Lacks reflectivity.** • Open-grid structure **reduces heat retention.**	• **Plowable and skid-resistant.** • **Fewer freeze-thaw issues** with well-drained base. • Compatible with **de-icing salts.**

Low Embodied Carbon UHI Mitigation Strategies

Photo Source: *Shutterstock*

The Issue

- The **materials** that make up cities, buildings, and infrastructure are **principal culprits in contributing to UHI and to global emissions.** Many prevalent materials in cityscapes **absorb and trap heat while also constituting some of the highest embodied carbon materials**.
- Choosing high embodied carbon materials can **accelerate and contribute to the problem of climate change**, which exacerbates UHI.
- **The need:** Recommendations for strategies that **reduce UHI** while **minimizing the carbon and environmental impacts of material choices** that do so.

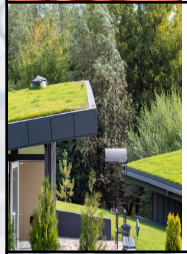


Source: Carbon Leadership Forum, based on data from World Resources Institute (WRI) and International Energy Agency (IEA)

Overview of Solutions Explored

UHI Reduction Strategy	Embodied Carbon Considerations	Sample Policy Approaches
Urban forests, parks, green corridors, and other greening measures	• **No embodied carbon impact of vegetation;** often net carbon sink. • For parks, **hardscapes and structures may add embodied carbon** but can be designed with low-carbon and reused materials.	• Climate Plans and Urban Heat Island Mitigation Plans • Municipal ordinances • Requirements for low-carbon materials in city-funded parks • Incentives for private-sector greening
High-emittance pavements	• Conventional concrete and asphalt are **carbon-heavy.** • However, low-carbon and high-emittance **alternatives exist.** • High-albedo coatings add material impacts and **do not eliminate the carbon footprint** of the underlying pavement but can **extend lifespan and reduce maintenance and replacement needs.**	• Pavement reflectance and GWP criteria in zoning/public works specifications • Pilot programs for cool and low-GWP pavements
Cool roofs and facades	• Polymer-based reflective coatings, membranes, and insulation can be **carbon-intensive.** • Frequent recoating or short service **life replicates embodied carbon impacts.** • **Favoring low-carbon (durable membranes, mineral based coatings, etc.) materials and coatings** where feasible can reduce embodied impacts.	• Building and zoning codes • Municipal ordinances • Minimum reflectance/emissivity and maximum project GWP standards
Green roofs and walls	• Structural reinforcement, plastic drainage layers, and growing media can **add embodied carbon.** • Use lightweight, bio-based growing media and recycled plastic or mineral drainage layers and prioritize extensive, low-structure systems on existing buildings to avoid major structural upgrades.	• Building and zoning codes • Design guidelines for low-GWP green roofs

Strategy Deep Dive: Roofing Products

Product Type with "Cool" Alternatives	Average Upfront GWP ($kgCO_2e/m^2$)	Embodied Carbon Considerations
 **Asphalt shingles**	3-6	• **High embodied carbon** from petroleum-based asphalt binders; not readily recyclable as roofing • **End-of-life** carbon contributions are significant • **Shorter lifespan** (15-30 years) requires more frequent replacements compared to metal, tile, slate • Lightweight compared to other products (less mass per square meter), meaning **less material is used overall**
 **Metal shingles**	Steel: 8-15 Aluminum: 20-40	• **High upfront emissions** associated with steel and aluminum production, but often contains **recycled content** • **Longer lifespan** (40-70 years) and high recyclability lowers lifetime embodied carbon
 **Concrete tile**	12-25	• **50+ year lifespan** minimizes replacements • **High upfront carbon** emissions of cement/concrete production
 **Clay tile**	8-20	• **50+ year lifespan** minimizes replacements • **Lower upfront carbon emissions** compared to concrete and other metals
 **Vegetated roofs**	20-60	• **Several layers accumulate impacts**: waterproofing + root barrier; drainage layer; filter fabric; growing media; **structural reinforcement** • **Benefits include longer lifespan** of membrane and carbon sequestration from greenery (reported separately) • Use lightweight, bio-based growing media and recycled plastic or mineral drainage layers and prioritize extensive, low-structure systems on existing buildings to avoid major structural upgrades.
 **Coatings, single-ply membrane**	3-12 depending on product	• Boosts adhesion, durability, and corrosion resistance, **extending service life of the roof** • **Medium lifespan** for single-ply membranes (20-30+ years) • May not alone offset roof embodied carbon but extends service life • **Emissions** associated with manufacturing, production, and transportation of **coatings relatively small**
 **Wood**	1-6	• **Smaller upfront carbon emissions** compared to asphalt, steel, aluminum, assuming responsible

For more information:
Visit: newbuildings.org
Email: ariel@newbuildings.org

BUILDINGENERGY BOSTON

Thank you!

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