Assessing the Effects of Local Cool Roof Policies on Urban Heat Islands

Comparative Analysis of Daytime and Nighttime UHI

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EPDM Roofing Association

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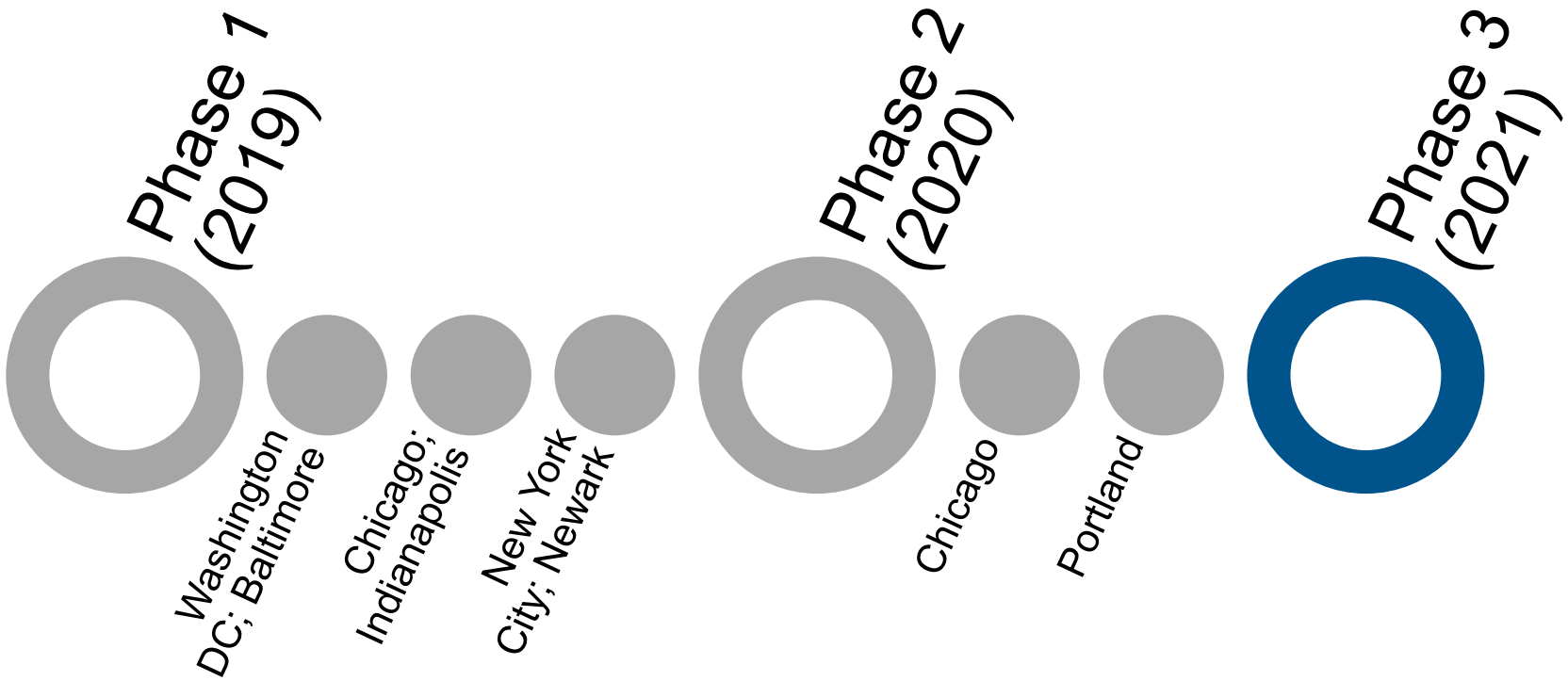
Research project timeline



Phase 1 (2019) – Analysis of select cities with cool roof mandates

- Objective
  - Estimate the incremental effect of commercial roof solar reflectance on UHI

- Methods
  - Analyzed ambient temperatures in three urban areas that have cool roof mandates in place
  - Compared temperatures to three similar localities that have not imposed such mandates
  - Analyzed corresponding changes in urban land surface color in those localities

- Results
  - No discernable correlation detected between the imposition of cool roof mandates and UHI

Phase 2 (2020) – Analysis of select cities with high UHI / white roofing

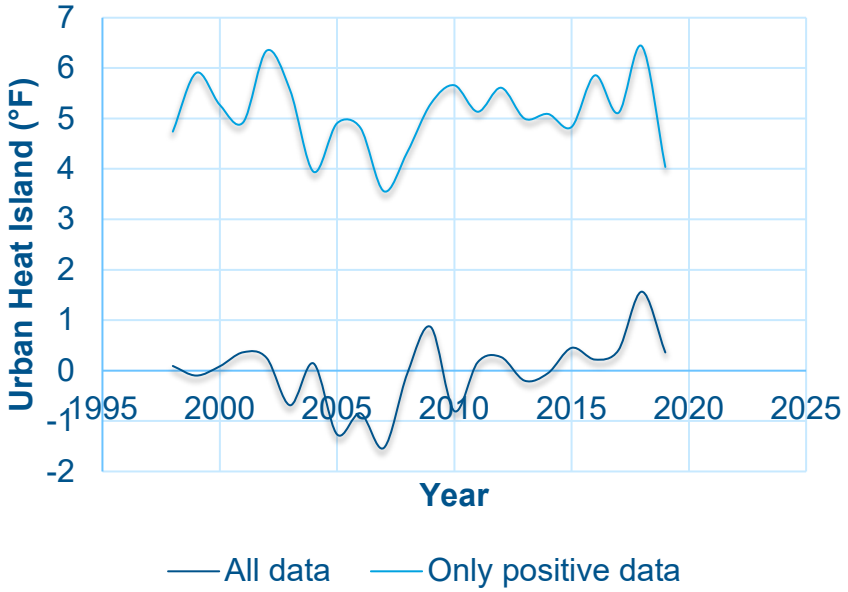
- Objective
  - Compare the strength and significance of daytime and nighttime UHIs with results published in the Climate Central study
  - Assess the probability of UHI being as prominent as indicated in the Climate Central study using alternate weather stations and summertime periods

- Methods
  - Strictly followed the **Climate Central** research team's stated methodology, **but also**
  - Analyzed **combinations** of weather stations and summer analysis timeframes
  - Compared daytime and nighttime UHI to Climate Central study

- Results
  - Daytime - UHI highly variable with uncertainty; much lower estimate than Climate Central study
  - Nighttime – UHI similar but lower than Climate Central study

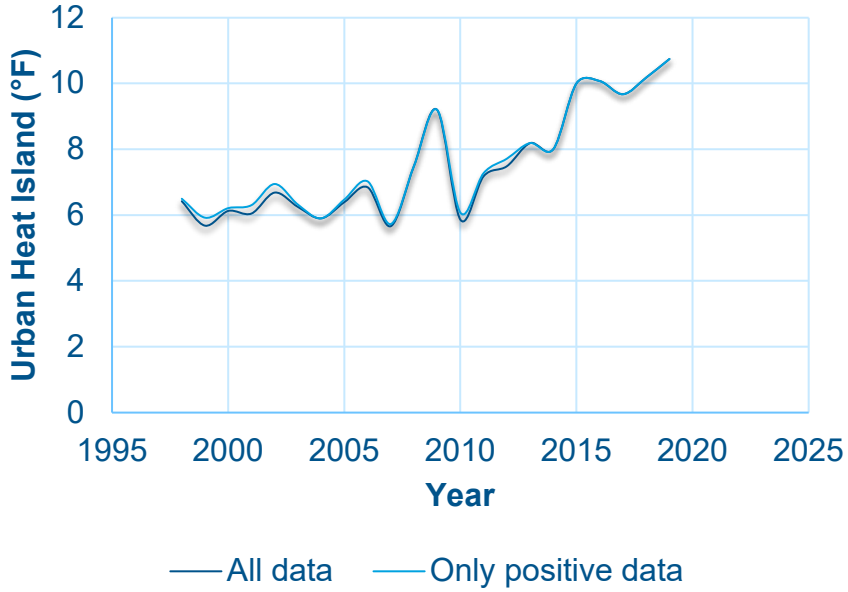
Phase 2 (2020) - Portland, Oregon

DAYTIME UHI



ICF 10-year Avg	-0.3	4.8
CC 10-year Avg =	4.8	

NIGHTTIME UHI



ICF 10-year Avg	7.0	7.1
CC 10-year Avg =	8.9	

Phase 3 (2021) - Comparative Analysis of Daytime and Nighttime UHI

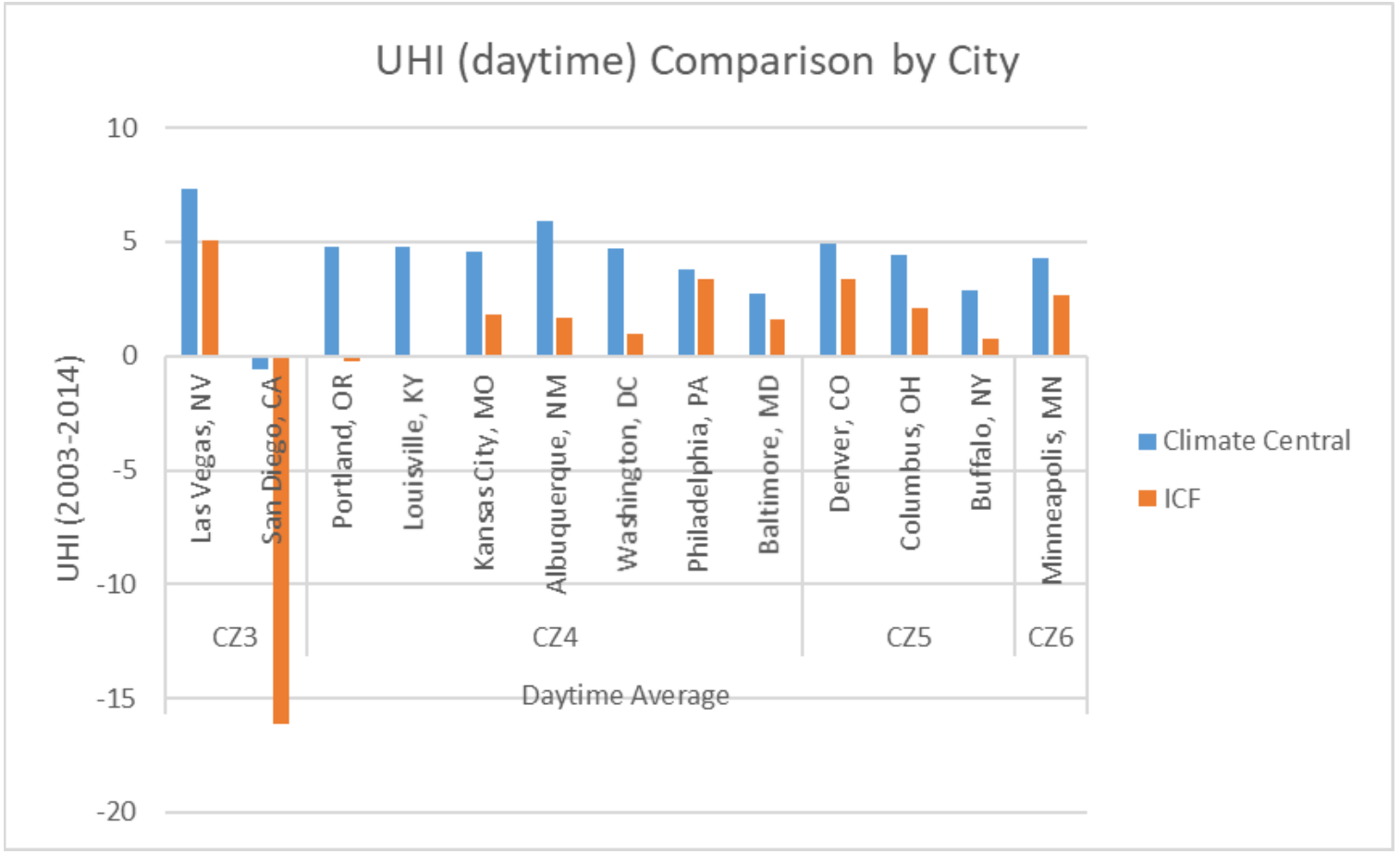
- Objectives (same as Phase 2)
  - Compare the strength and significance of daytime and nighttime UHIs with results published in the Climate Central study
  - Assess the probability of UHI being as prominent as indicated in the Climate Central study using alternate weather stations and summertime periods

- Methods (same as Phase 2)
  - Strictly followed the **Climate Central** research team's stated methodology, **but also**
  - Analyzed **combinations** of weather stations and summer analysis timeframes
  - Compared daytime and nighttime UHI to Climate Central study

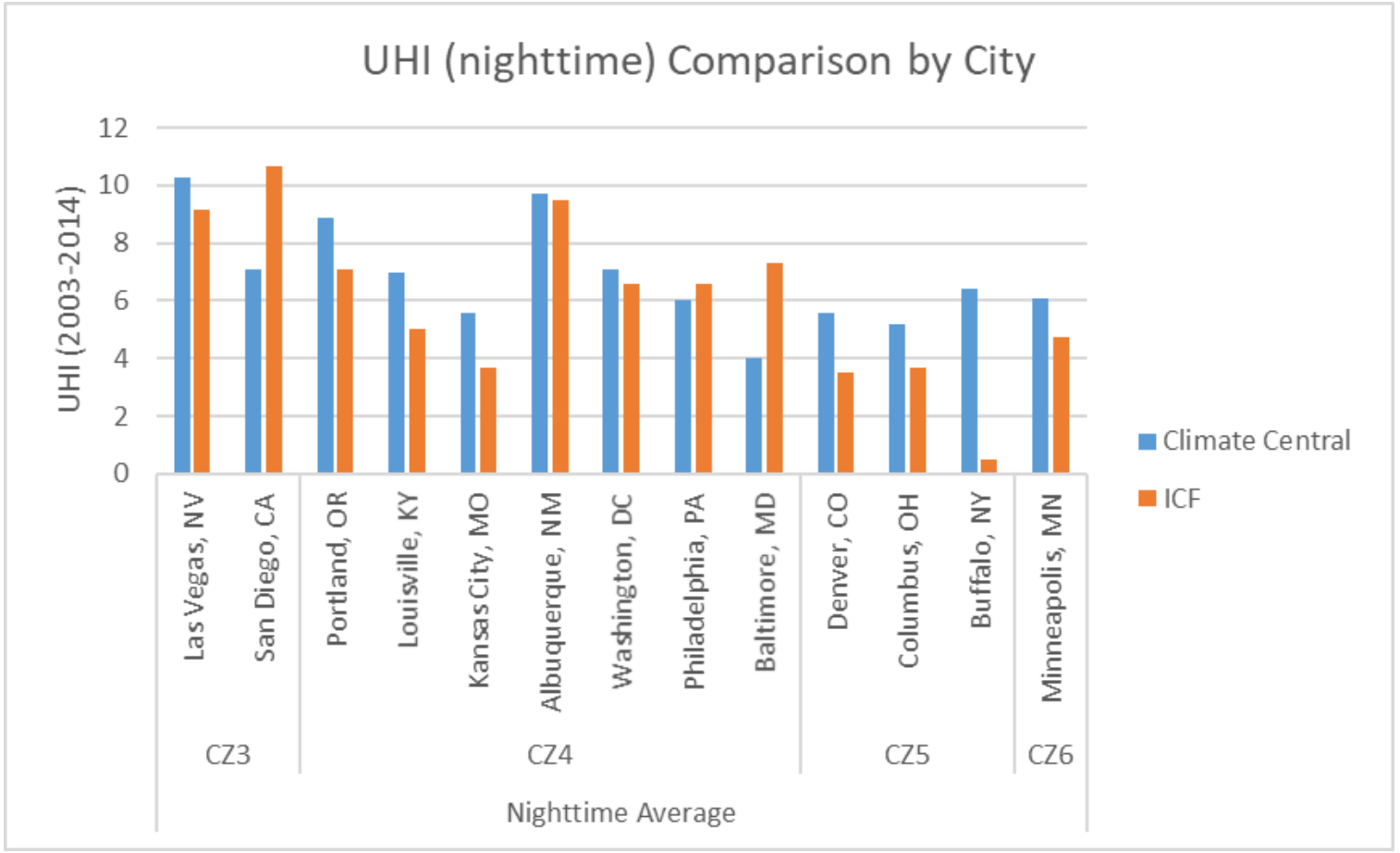
Phase 3 (2021) - Results

- The analysis was unable to replicate the Climate Central study results
- Daytime UHI values were consistently lower than those published in the Climate Central report and are more closely aligned when negative UHI's are filtered out
- In contrast, nighttime UHI was always strong and significant
- UHI tends to be highly variable based the definition used: selection of weather stations, period analyzed, analysis horizon, and calculation method
- There tends to be more variation in daytime UHI than nighttime UHI and more variation in daytime UHI in warmer compared to cooler climate zones
- Roughly the same number of cities exhibited an increasing trend in UHI compared to either a decreasing trend or no change in UHI over the analysis period - for both daytime and nighttime

UHI Comparative Analysis Results – Daytime UHI



UHI Comparative Analysis Results – Nighttime UHI



Phase 3 (2021) – Takeaways

- The inability to reproduce the Climate Central study results, combined with UHI variability seems to undermine
  - The credibility of the analyses for which cooling roof policies may be based
  - Air temperature as the only variable for assessing impacts from UHI
- Cool roofs were not found to noticeably reduce UHI over the course of this study
  - They may be just one factor - alongside local wind patterns, green spaces, trees, bodies of water, all other surfaces like sidewalks which are closer to human height, presence of air conditioning, etc.