HOT ZONES, COOL HOMES:
RETHINKING BUILDING EFFICIENCY IN A WARMING CLIMATE

Benjamin Cheah & Jean Shelton, Verdant Associates
Mary Sutter, Grounded Research
Chris Cone, Sonoma County Transportation and Climate Authorities (a BayREN Member)

Introduction

This poster presents findings from Heat Mitigation Pilot Research performed for the Bay Area Regional Energy Network (BayREN). Climate change is causing extreme high and low temperatures, and associated weather and wildfire events pose new threats to human health. Within the San Francisco Bay Area (Bay Area), much of the building stock was constructed for a milder climate that did not require both heating and cooling. However, the increase in temperature extremes highlight that past building practices are falling short in their ability to create livable indoor environments for existing buildings (although codes for new construction point to buildings being better able to manage extreme heat).

The Federal Emergency Management Agency (FEMA) "defines an extreme heat event as a long period (2 to 3 days) of high heat and humidity with [outdoor] temperatures above 90 degrees Fahrenheit." According to FEMA, "The increase in frequency and time of these heat events is a major cause for concern as extreme heat is expected to continue threatening the wellbeing of families and vulnerable populations. Extreme heat-related deaths significantly outnumber those caused by any other weather-related disaster. Low-income households are more likely to suffer from extreme heat and other natural disasters, creating financial and health concerns that impact individuals' and families' wellbeing.

The California Office of Environmental Health Hazard Assessment estimates that Bay Area counties are projected to experience up to a 57% increase in days over 90°F by 2035. By the Mid-Century, the counties in the Bay Area are expected to see an increase in the number days of a heat event (where temperatures do not drop below the extreme heat threshold of 90°F), between 150% and 220%. Solano county, for example, has historically seen heat events lasting 13 days, on average. By the mid-century, this number is expected to last almost a full month.

To address these concerns, BayREN commissioned research to understand what can be done to make indoor environments livable. Our research explores the potential for homes to better withstand heat through the installation of passive and mechanical energy efficiency measures. Utilizing a combination of NREL's Building Energy Optimization Tool (BeOpt) and OpenStudio software to simulate single family, multifamily (mid-floor, corner units), and multifamily (ground-floor, middle units) building performance for the primary four BayREN climate zones (2, 3, 4, and 12), we evaluate the ability several high-efficiency measures to mitigate high heat events. Our simulations include passive strategies such as interior shading, exterior reflective paint, radiant barriers, and insulation, as well as mechanical measures like whole-house fans and air source heat pumps. The study compares the impact of individual measures on indoor air temperatures and energy consumption, as well as the cumulative effect of a combination of measures to identify which strategies are most effective at reducing resident exposure to potentially health-adverse temperatures. While our research focuses on the impact for homes without existing air conditioning, passive cooling strategies can significantly reduce heat gain, while simultaneously reduce energy consumption in homes that do have existing and functional air conditioning equipment.

In conclusion, our research provides valuable insights into the potential for both passive measures and building efficiency measures to mitigate the adverse effects of extreme heat. This preliminary research highlights that heat mitigation can go hand in hand with energy efficiency, and that an increased implementation of passive measures into energy efficiency programs may play a dual role to communities facing the challenges of rising energy costs confounded by the potential for increasing climate-related health risks. These findings may be useful

for policymakers and program administrators who are looking for alternative ways to increase program participation, promote energy equity, and incorporate climate resiliency into their energy programs.