A BETTER CITY

CASE STUDIES:

HOW BOSTON ORGANIZATIONS AND INSTITUTIONS CAN ENGAGE IN COMMUNITY HEAT RESILIENCE INITIATIVES

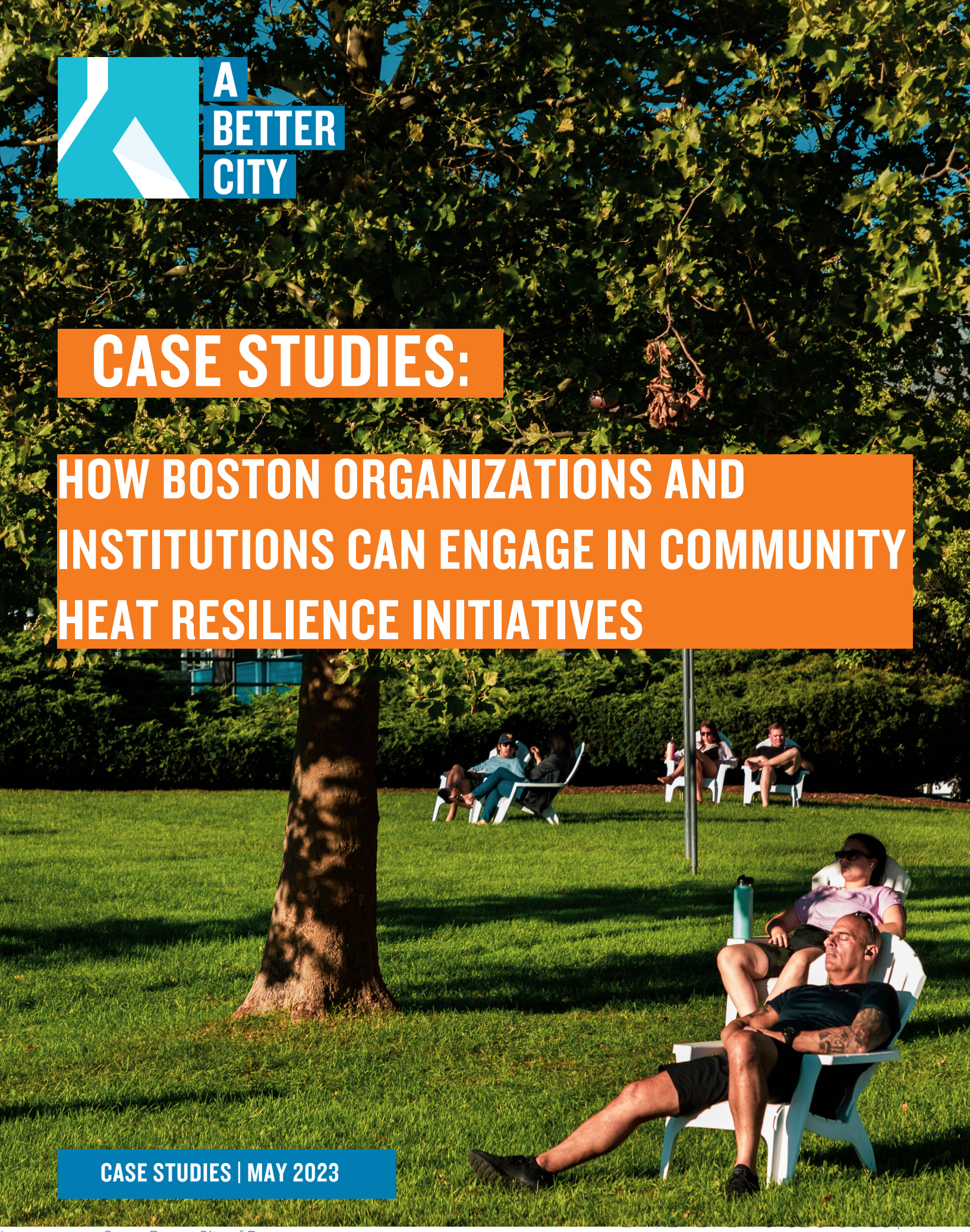

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Image source: Casey Brown City of Boston

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A Better City represents a multi-sector group of nearly 130 business leaders united around a common goal: to enhance the Greater Boston region's economic health, competitiveness, equitable growth, sustainability, and quality of life for all communities. By amplifying the voice of the business community through collaboration and consensus-building, A Better City develops solutions and influences policy in three critical areas: 1. transportation and infrastructure, 2. land use and development, and 3. energy and the environment. A Better City is committed to building an equitable and inclusive future for the region that benefits and uplifts residents, workers, and businesses in Greater Boston.

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INTRODUCTION

Many A Better City member businesses and institutions are working to advance innovative strategies that enhance community heat resilience. To spotlight these leaders and to encourage others to engage in heat interventions through their own work, A Better City is compiling case studies of member businesses, institutions, and partner organizations that are leading the way. While this is not a comprehensive list, these examples can be helpful in inspiring others to lead by example, and to support and uplift the work of community-based organizations that work to protect and provide relief in heat island communities. If you would like to suggest an organization or project to feature in a future case study, then please contact Isabella Gambill.

HEALTHCARE:
BOSTON MEDICAL CENTER

Location:

Boston (South End & Fairmount Corridor)

Lead:

Dr. Megan Sandel, MD, MPH, Pediatrician & Co-Director of Boston Medical Center's GROW Clinic; Co-Lead Principal Investigator with Children's Health Watch; and Professor of Pediatrics at the Boston University Chobanian and Avedisian School of Medicine and Boston University School of Public Health.

Project Highlights:

- Screening patients for heat vulnerability
- Greening rooftops for heat resilience and food security
- Supporting heat vulnerable patient populations
- Leveraging energy efficiency and renewable energy to minimize grid demand
- Targeting community investments for community resilience

Case Study Context

As stated in their mission, for over 100 years, Boston Medical Center (BMC) has been a leading community healthcare provider serving patients in the Greater Boston area, regardless of their ability to pay. With a focus on caring for patients' ability to thrive, and a vision for Boston to be the healthiest urban population in the world by 2030, BMC is considered the number one safety net hospital in New England. Many BMC patients come from environmental justice communities and communities of color that are on the frontlines of climate threats like extreme heat, on top of compounding legacies of community disinvestment.

To promote healthier communities and a healthier planet, BMC continues to be a healthcare and climate leader by implementing climate solutions in their facilities, integrating climate-informed community care in their patient interactions, and centering vulnerable communities throughout their community investments. Extreme heat is a leading climate threat to BMC patient populations, so many physicians and staff are interested in preventing heat-related illnesses and deaths in their patients.

BMC aims to understand and address patient physiological needs including access to water, food, and cooling, as well as safety and security needs like housing stability and the ability to afford utility bills. The latter becomes especially important during heat emergencies for those unable to afford turning on an air conditioner in their homes. As BMC's Dr. Megan Sandel and others point out, extreme heat vulnerability and energy insecurity go hand in hand, and addressing extreme heat in patient populations requires systemic approaches to affordable energy access, affordable housing, and employment, in addition to physician interventions in patient heat-related illnesses. By the time a patient presents to a BMC physician with a heat-related illness, heat interventions are limited to treating the symptom rather than the systemic root cause of extreme heat vulnerability.

In addition to providing healthcare responses to patient illnesses in extreme heat emergencies, healthcare institutions like BMC are also required to think more proactively about how to support social resilience, connectedness, and investments in communities most affected by extreme heat. They are, therefore, rethinking patient screenings for social determinants of health, how to support core vulnerabilities (like food, housing, and energy bill assistance), and how to support community heat resilience policy interventions that focus on local and place-based solutions.

In A Better City's September 2022 extreme heat event, Dr. Megan Sandel highlighted BMC's ongoing efforts to reduce their carbon footprint and upgrade their buildings, to provide patient screenings and community care, and to target community investments that help promote community health, wealth building, and resilience. Most of the details in this case study are informed by Dr. Sandel's presentation and leadership of BMC's heat resilience solutions.

Project 1: Patient Heat Vulnerability Screenings

To help facilitate patient screening for heat vulnerability and other health threats related to social determinants of health, BMC uses a tool called the THRIVE screening tool[1,2], which screens patients across eight different domains: housing, food, affordability of medications, transportation, utilities access, caregiving, employment, and education. Offered in six different languages to patients seeking care at BMC, the THRIVE tool identifies patient needs prior to acute health emergencies and connects patients to different services. In the case of heat-related vulnerability, this may include connecting patients to services that provide electricity shut off protection and access to low-income home energy assistance programs. Beyond the physician-patient screenings, BMC also partners with community-based organizations like Communities Responding to Extreme Weather (see related case study on CREW), to meet with local communities and help educate them on heat preparedness. In addition to patient screenings, BMC is also in the early stages of tackling data gaps for heat-related illnesses and deaths within Boston's healthcare community. These data will help to clarify the current scale of threat and to target heat resilience investments in the most vulnerable patient populations.

Project 2: Green Building, Green Power, & Green Roofs

BMC is known for its climate commitments and leadership, recognized as one of the 60 greenest hospitals in America, according to Becker's Hospital Review.[3] It has a goal of carbon neutrality by 2030 (96% complete as of 2022) and leads by example including the construction of net-zero healthcare facilities like the recently completed BMC Brockton Behavioral Health Center, which is considered the first net-zero healthcare facility of its kind in New England, if not the country.[4] BMC has also invested in a 650-acre renewable energy solar farm through the A Better City convened power purchase agreement with MIT and Friends of Post of Square. This innovative 25-year power purchase agreement (PPA) amongst A Better City members involved the nation's largest power purchase agreement at the time, with 60 megawatts (MW) of solar energy integrated into the North Carolina grid by the end of 2022, which enabled Boston Medical Center and other benefactors to power their facilities with clean energy.[5] BMC is also committed to providing healthier hospital facilities as a conduit to healthier and more resilient communities, patients, and people. Therefore, alongside greenhouse gas (GHG) reduction goals that help to minimize energy demand on the grid during and beyond heat emergencies, BMC also has a hospital-based rooftop farm, which doubles as a green roof minimizing energy consumption and building temperature while also providing access to organic and affordable food for BMC patients.[6]

Source: Recover Green Rooftops, Boston Medical Center

Source: Boston Medical Center Rooftop Farm

Community Impact

One of BMC's core strategies for addressing community heat resilience is through place-based and community investing that helps to address systemic and structural issues causing environmental justice neighborhoods and communities of color to be particularly vulnerable to extreme heat. With equitable hiring and workforce development practices, local sourcing to support and invest in small businesses, and place-based investing in community projects, BMC continues to provide opportunities to enhance BIPOC (Black, Indigenous, and People of Color) community wealth-building and social resilience that will also provide the co-benefit of heat resilience. For example, BMC invests in affordable and energy efficient housing as a proven long-term intervention for heat-vulnerable unhoused and energy insecure patients. BMC prioritizes investing in affordable housing that is near transportation and that meets certain energy efficiency criteria, linking housing, energy, and mobility for climate and community resilience. Through an initiative called the Boston Opportunity System (BOS) Collaborative[7] that seeks to invest in housing and wealth building in transit-oriented communities, BMC invested in the Nubian Market project in Nubian Square, which will provide hundreds of new apartments alongside a Halal supermarket for the Roxbury community. By leveraging place-based investing as part of Boston Medical Center's overall Healthcare Anchor Network strategy, BMC partners with housing organizations to help support the expansion of affordable housing, even though BMC is not an owner or operator of affordable housing buildings. Several of BMC's community resilience investments have focused on the Fairmount Corridor where many of their patients live. Their goal is to bring jobs, housing stability, and an electrified commuter rail to BMC patients located in communities like Roxbury, Dorchester, and Mattapan.

Transferable Heat Interventions

There are many opportunities to replicate Boston Medical Center's leadership in supporting community heat resilience, both in healthcare facilities and in the broader business community. Other building owners, building operators, and institutional landowners could consider the following:

Healthcare Institutions

- Implementing patient screening tools for social determinants of health to gather quantitative and qualitative data on heat vulnerability, exposure, and illness/death
- Utilizing emergency room visits, hospital visits and check-ups, and community health center visits to disseminate information to patients on heat safety, vulnerability, and resources for relief
- Working across healthcare institutions to provide quantitative and qualitative data on heat

vulnerability, illness, and death in Massachusetts

Healthcare and Beyond

- Developing green roofs/rooftop gardens like healing gardens (in a healthcare setting), which provide enhanced patient well-being and onsite temperature reduction, and/or rooftop farms
- Scaling up energy efficiency programs across building portfolios to reduce emissions, reduce building temperature, minimize demand on the electricity grid, and reduce buildings' energy bills
- Investing in virtual power purchase agreements (vPPAs)
- Leading by example with innovative net-zero buildings like the first-of-its-kind net-zero in-patient psychiatric facility Brockton Behavioral Health Center
- Orienting investment portfolios to prioritize community resilience investments in housing stability, reduction of energy burden in low-income communities, transit-oriented development, community wealth-building, small businesses, etc.

Source: Boston Medical Center Rooftop Farm

ACADEMIC & COMMUNITY-BASED ORGANIZATION PARTNERSHIP: BOSTON UNIVERSITY & GREENROOTS, C-HEAT PROJECT

Location:

Chelsea & East Boston

Leads:

Dr. M. Patricia Fabian, ScD, Co-Principal Investigator, C-HEAT Project; Associate Professor of Environmental Health & Associate Director at the Institute for Global Sustainability at Boston University; and Boston site Principal Investigator for the Consortium for Climate Risk in the Northeast (CCRUN)

Dr. Madeline Scammell, DSc, Co-Principal Investigator, C-HEAT Project; Associate Professor of Environmental Health & Director of the Local Public Health Institute at Boston University's School of Public Health; and JPB Environmental Health Fellow at Harvard School of Public Health

Bianca Bowman, Climate Justice Coordinator & C-HEAT Lead Partner at GreenRoots

Project Highlights:

- Activating vacant lots for green infrastructure and community heat interventions
- Developing community-informed heat solutions
- Encouraging participatory temperature mapping
- Connecting tree planting with community employment
- Facilitating community-informed heat solutions

Case Study Context

The Chelsea/East Boston Heat Study (C-HEAT) project is an ongoing partnership between the community-based environmental justice organization, GreenRoots, and higher educational leaders from Boston University's School of Public Health, funded by the Barr Foundation.[8] C-HEAT is prioritizing building capacity to respond to extreme heat and mitigating heat island effects in the neighboring environmental justice communities of Chelsea and East Boston, both of which are predominantly immigrant communities, with high urban density and significant portions of their populations living below the poverty line.

Chelsea has about 2% tree canopy cover (compared to Boston's average tree canopy of 27%), 4% public green space, an average of 80% impervious surfaces, and temperatures as high as 10-15 degrees[9] warmer than other parts of Greater Boston during heat emergencies. Additionally, many residents live with asthma exacerbated by air pollution and are English-isolated renters, compounding climate and social vulnerabilities that make them particularly sensitive to heat-related illness, stress, and death.

Project I: C-HEAT Participatory Heat Mapping

One project that C-HEAT is pursuing is a community-led participatory heat mapping and research effort alongside a "Cool Block" initiative with GreenRoots, Boston University, the City of Chelsea, and other partners, which involves implementing a series of layered heat resilience interventions in one of Chelsea's hottest city blocks. The C-HEAT team carried out a number of temperature measurement campaigns over the summers of 2021 and 2022. First, they used satellite temperature data to locate heat islands (temperature hotspots) across the city. They also installed temperature sensors in trees around Chelsea & East Boston as well as inside buildings and on rooftops to collect

indoor and outdoor temperatures throughout the hottest summer months, and particularly during heat emergency declarations. These measurements showed that Chelsea and East Boston are on average 6 degrees warmer than what the National Weather Station's readings were showing for Boston, and that on a hot day, a downtown Chelsea neighborhood was 9 degrees hotter than a neighborhood near a large park. In a summer 2021 data collection campaign, Environmental Chelsea Organizers (ECO Crew) measured surface temperatures on park features like benches, slides, and climbing structures at various times of day, and measured the highest recorded surface temperature of 130 degrees on a park bench.[10,11]

Using heat sensor and heat mapping data, alongside robust community engagement with residents and with input from an advisory team of municipal officials from Chelsea and Boston as well as from other community-based and regional planning organizations specializing in community heat resilience, the C-HEAT team identified the hotspot within Chelsea located on Congress Avenue. The C-HEAT team chose to focus on the residential neighborhood on and nearby Congress Avenue, to reimagine this specific sub-neighborhood hotspot as the "Cool Block Project" for layered and community-informed cooling interventions (see more below).[12] This city block on Congress Avenue is bookended by a vacant privately owned lot and a Boys & Girls Club, with multi-family buildings and concrete-heavy parking lots instead of backyards in between. Prior to the Cool Block project, this block had only five small trees and lived experiences with heat were described as "oppressive and blinding."[13]

Project 2: "Cool Block" Heat Mitigation Strategy

In a first for Greater Boston, the Cool Block Project is layering multiple short- and long-term heat interventions onto one city block, to maximize heat relief and explore different solutions for this local community. As a long-term heat resilience solution, the C-HEAT team partnered with the Department of Conservation, the City of Chelsea, and residents to help plant approximately 100 new elm, crabapple, cherry, and hawthorn trees, increasing tree canopy and tree equity. With the financial support of a COVID-Safe Cooling Grant that GreenRoots received in summer of 2022, they are also paying residents to water the trees and care for them over time, providing employment opportunities to residents interested in tree stewardship and maintenance. Near the Boys & Girls Club, sidewalks have been replaced by permeable pavers, with added green infrastructure features like planters, and reflective white concrete that is less likely to retain heat than typical dark asphalt. In addition, with the support of a state Municipal Vulnerability Preparedness (MVP) planning grant, the City of Chelsea plans to paint the roof of the Boys & Girls Club white, which is expected to lower the surface temperature by up to 20 degrees and the surrounding air temperature by 7-10 degrees in the summertime. Finally, through intentional community engagement led by GreenRoots, and in partnership with with Boston Society of Landscape Architects, local residents, and the C-HEAT team, this project is also supporting the reimagination and conversion of a formerly vacant lot into a community green space for heat relief. With GreenRoots helping to continue heat mapping of the formerly vacant lot to measure impact over time, the Boston Society of Landscape Architects also helped to support community engagement and co-design work for the parcel in summer 2022, thanks to the support of the Barr Foundation. The total cost of the tree plantings, road and sidewalk surfacing, green infrastructure planting installations, Boys & Girls Club white roof, and the transformation of the vacant lot into a park is estimated to be around $350,000, most of which will come from a Municipal Vulnerability Preparedness (MVP) Program state grant as well as additional grant support from the Barr Foundation.[14]

Researchers from the C-HEAT team and BU's School of Public Health have placed heat sensors in the Cool Block trees to track how layered heat interventions impact real-feel temperature on the ground, and in the summer of 2023, this will be expanded to also monitor surface, air, and satellite temperature measurements to record the impact of the layered cooling strategies. The C-HEAT project also includes a publicly accessible data dashboard mapping population vulnerabilities, as well as community and resident assets, including air conditioners, central air, and heat pumps across the study's neighborhoods. In an effort to leverage heat sensor data as well as qualitative data on heat resilience, C-HEAT is looking to: quantify the impact of cooling

strategies like white roofs, trees, and cool pavement on local temperatures and neighborhood heat islands; to investigate barriers to participation in decarbonization and weatherization programs; to compile state and federal policies to adapt to extreme heat, and; to characterize occupational heat exposures, alongside targeted heat interventions on the Cool Block Project.

Source: Isabella Gambill, GRCx C-HEAT Tour, October 11, 2022

Community Impact

Boston University researchers and GreenRoots staff from the C-HEAT team testified at a Chelsea City Council meeting, alongside local residents and families and in partnership with the vacant lot owner, to have the 212 Congress Avenue site accepted as a land grant donation to the City of Chelsea.[15] With a unanimous vote on November 7, 2022, the 212 Congress Avenue site permanently became protected as a public park or open space for the benefit of the Chelsea community. It will be designed and maintained in partnership with the C-HEAT team and local residents. Building upon the team's efforts to design and transform the vacant lot into a park, it will continue to implement layered heat interventions, providing a central heat relief and gathering space for the residents near Congress Avenue's hotspot community. As demonstrated on a recent GRCx C-HEAT project tour, the vacant lot already has new play structures and seating spaces, designed for multi-generational gatherings, that were made by GreenRoots staff, Boston Society of Landscape Architects, and local residents. Colorful reclaimed electrical cable spools were painted to become planters that double as tables, and lobster traps were painted and repurposed to create a lobster trap maze, a Chelsea take on a corn maze.

By intentionally starting small and by partnering with the local community, the C-HEAT project demonstrates a model for small-scale community resilience solutions that can be replicated elsewhere.[16] They have addressed urban heat island in a way that identifies hotspots, works hand in hand with researchers, community organizers, and residents on a community-based and participatory research project, and listens to community input for designing and reimagining a public space in partnership with Boston Society of Landscape Architects and GreenRoots. C-HEAT's work centers folks who are impacted worst and first by climate threats, and who are both carrying

the heaviest burden while also being the least capable of bouncing back from heat emergencies. Finally, C-HEAT also highlights that *process* in our climate solutions matters; the project could have the most pristine and beautiful park space but not ever be utilized by the local community. Instead, the park space at 212 Congress Avenue is a vibrant community-created space that sees residents of all ages coming together, with multiple languages and generations claiming it as their own in a clear testament to C-HEAT's intentional community organizing.

Transferable Heat Interventions

The C-HEAT project offers a variety of opportunities for other building owners, building operators, and institutional landowners to replicate, including:

- Installing heat sensors on buildings and private land, including privately owned public spaces, to provide dynamic information on street surface temperatures and air quality, and to help prioritize and inform targeted heat interventions by city block
- Assessing any vacant and/or underutilized land that might be appropriate for conversion into a publicly accessible community green space, through tools like a land grant donation and/or conservation easement; Engaging local residents and community groups to help design a customized community space
- Considering opportunities to engage in participatory heat mapping in partnership with local community-based organizations and leaders (this is especially relevant for higher education and research institutions)
- Sponsoring the deployment of additional street trees where possible (both on private and public land) and employing local residents in heat vulnerable communities to help water and maintain street trees on their block
- Partnering with local community-based organizations like the Boys & Girls Club to collaborate on cool block and sub-neighborhood heat interventions
- Painting rooftops white and/or with reflective paint to reduce the temperature of a building and the amount of heat that it radiates into surrounding communities
- Implementing green infrastructure solutions and stormwater management solutions that provide heat co-benefits

CULTURAL INSTITUTION & COMMUNITY-BASED ORGANIZATION PARTNERSHIP: MUSEUM OF SCIENCE & MYSTIC RIVER WATERSHED ASSOCIATION (MyRWA)

Location:

Boston & Mystic River Watershed

Leads:

Dr. David Sittenfeld, PhD, Director of Current Science Communication at the Museum of Science & Museum of Science Co-Lead, Wicked Hot Boston and Wicked Hot Mystic Projects

Sara Winslow, Current Science Communication Education Associate at the Museum of Science & Museum of Science Co-Lead, Wicked Hot Boston and Wicked Hot Mystic Projects

Katie Baur, Associate Project Manager of Current Science Communication at the Museum of Science & Museum of Science Co-Lead, Wicked Hot Boston and Wicked Hot Mystic Projects

Project Highlights:

- Encouraging participatory heat mapping
- Developing community-informed heat resilience solutions
- Using cultural institutions as cooling centers
- Wicked Hot Boston & Wicked Hot Mystic Projects

Case Study Context

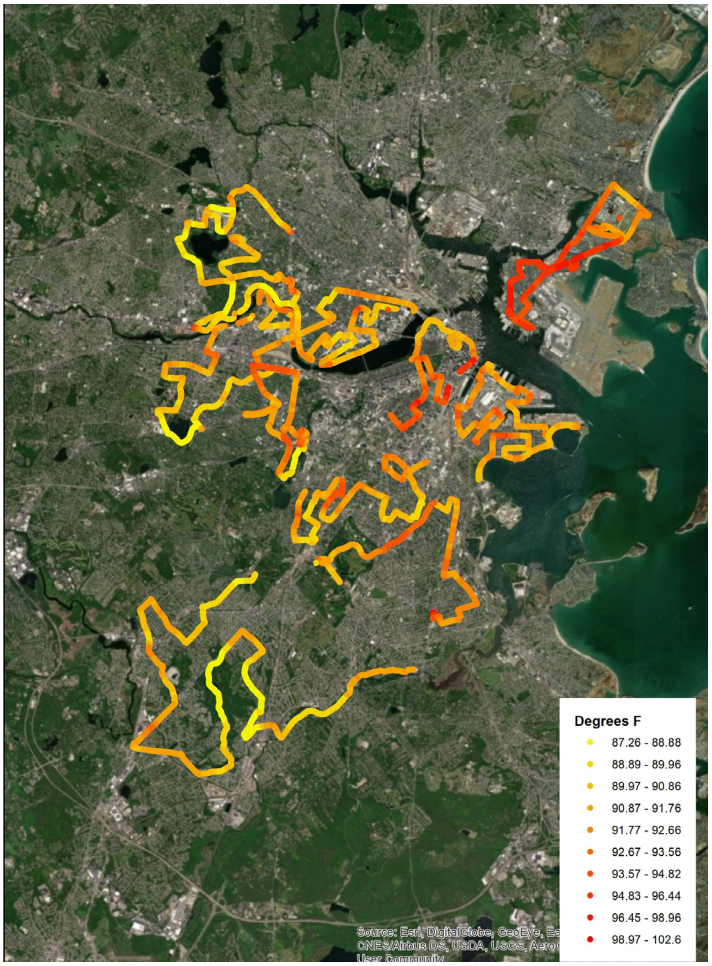
As one of Boston's leading cultural institutions, the Museum of Science has long been helping to educate and inspire members, residents, families, policy makers, and local communities about the importance of global scientific phenomena, alongside the unique characteristics of Boston's local environment. It is a leading cultural institution seeking to engage residents and local communities in community-based participatory science, or "citizen science." Beginning in 2019 with the Wicked Hot Boston project, conducted in collaboration with Northeastern University, and followed by the subsequent Wicked Hot Mystic project in collaboration with the Mystic River Watershed Association and others, the Museum of Science has demonstrated how a cultural institution can engage in community heat resilience work while staying true to its mission. Through its role as project lead and facilitator, the Museum of Science helped to provide three municipalities across Metro Boston with vital heat mapping data, while also engaging residents and the greater public around heat resilience and climate change efforts in a way that empowered them to be part of the solution. Additionally, both the Wicked Hot Boston and Wicked Hot Mystic projects were part of a national project led by the National Oceanographic and Atmospheric Administration (NOAA) and CAPA Strategies that has now replicated similar initiatives in over 60 cities across the United States.[17]

Wicked Hot Boston

In July and August 2019, the Museum of Science gathered 50 citizen scientist volunteers comprised of non-government organization representatives, city planners, university students, community members, and professionals, all interested in participating in the Museum's first citizen science heat mapping initiative. Through their efforts, the Wicked Hot Boston project collected vital data for measuring extreme heat during heat emergencies in and around ten neighborhoods of Boston, Brookline, and Cambridge.[18] The Wicked Hot Boston data provided city planners in Boston, Brookline, and Cambridge with high resolution and customized temperature data that could then be layered with additional geospatial data relevant to tree canopy, surface temperature, income level, elderly populations, and/or emergency room visits in the municipality. Having customized heat maps with neighborhood and community-specific data helps to clarify and target the populations and areas most affected by and at risk from urban heat.

Using heat sensors provided by CAPA Strategies as part of an ongoing national project, volunteer citizen scientists worked with Museum of Science staff to measure temperature and humidity levels across the ten neighborhoods during officially designated heat wave events, with three measurements taken at 6 AM, 3 PM, and 7 PM. The data were collected with a 3-D printed car mount that contained heat and humidity sensing equipment that allowed the citizen science participants to collect ambient air temperature and geospatial data while driving around the designated neighborhoods.[19,20,21]

The online GIS heat mapping viewer shows modeled temperatures of Boston during a heat wave at 3 PM, based on data collected by the Wicked Hot project in 2019.[22] A static view of the heat sensor data collected by citizen scientist drivers across neighborhoods within Boston, Brookline, and Cambridge, can be seen in the following screenshot.



Source: Wicked Hot Boston, Museum of Science[23]

In September 2019, the Wicked Hot Boston project held a forum with around 100 participants to review presentations of the heat mapping data, and to deliberate on potential community heat resilience solutions. By combining data collected by citizen scientists with geospatial land satellite data, the project modeled "real feel" temperatures during heat wave events across neighborhoods that were not collected.[24] Through this methodology, the Wicked Hot Boston team was able to identify distinct neighborhoods within urban heat island communities that had exceedingly high absolute and real-feel temperatures. While the high absolute air temperature recorded at Logan Airport during the study was 92 degrees, the highest temperature recorded during the heat mapping study was in Dorchester, reaching 102.6 degrees, showing a difference of over 10 degrees. In the Wicked Hot Boston study, some of the hottest communities were the South End, East Boston, the Seaport, North End, and Dorchester, with an overall difference of 15 degrees between the warmest and coolest neighborhoods of the city measured at 3 PM

during a heat wave — as mentioned previously, the hottest temperature recorded at 3 PM was in Dorchester, with 102.6 degrees actual temperature and a heat index of 109.5 degrees while at the same time of day, 87.3 degrees was measured across the city near the Chestnut Hill Reservoir.[25] In the summer of 2022, the Museum of Science also held an Extreme Heat Boston Forum that further solicited community member input into heat resilience planning, and produced a story map of heat experiences in Boston, which further helped with community engagement and ongoing education, awareness, and communication around heat.[26]

Community Impact

Wicked Hot Boston data found significant variation in how communities experience heat waves in Boston, both in their actual recorded highest temperatures during a heat wave event, as well as high temperature duration, and even hotter "real feel" heat index temperatures. Through these data, the Museum of Science and citizen scientist researchers are working with civic partners to better understand hotspots within Boston's urban heat island communities, how to help protect these areas from the impacts of extreme heat in the future, and how to use similar methodologies to explore resilience planning for other climate hazards like sea level rise, extreme precipitation, and drought. In addition to having substantial significance to the City of Boston's heat resilience efforts, Wicked Hot Boston also offers a model for citizen science heat resilience projects that facilitate community participation in data collection, mapping of heat experiences, and in the development and design of community heat resilience solutions.

Wicked Hot Mystic

The Wicked Hot Mystic project builds upon the Wicked Hot Boston initiative, and is funded as part of a national heat mapping campaign led by the National Oceanic and Atmospheric Administration, as previously mentioned. In partnership with the Resilient Mystic River Collaborative (RMC), Mystic River Watershed Association (MyRWA), Northeastern University, CAPA Strategies, and the Metropolitan Area Planning Council, the Museum of Science built upon the Wicked Hot Boston project to expand heat mapping and heat resilience work beyond the City of Boston to the Mystic River Watershed, which encompasses 21 different municipalities across Greater Boston. Operating as a collective partnership co-led by the Museum of Science and MyRWA, the Wicked Hot Mystic project sought to: collect high resolution temperature and air quality data via volunteer citizen scientists; create heat and air quality maps to identify neighborhoods with highest extreme heat burden; increase community engagement in heat resilience; and communicate heat mapping data to civic partners, community groups, and the general public. From August 12-13, 2021, over 80 volunteer citizen scientists worked with the Museum of Science and Mystic River Watershed Association to measure ground-level air temperature, humidity, and air particulate matter by using heat sensors mounted on cars and bikes, traveling along 19 predetermined transects at 6AM, 3PM, and 7PM, followed by a final reading at 6AM the following morning. As with Wicked Hot Boston, CAPA heat sensors were used to record ambient air temperature, in addition to new AirBeam air quality sensors,[27] which measure fine particulate matter (one standard for assessing ambient air pollution).[28] Through an online citizen science platform called ISeeChange,[29] Wicked Hot Mystic participants could also document and post their personal experience living with heat in Mystic River Watershed neighborhoods.[30]

Community Impact

In July 2022, Wicked Hot Mystic released the data in collaborative partnership with the Museum of Science, Mystic River Watershed Association, Resilient Mystic Collaborative, and the Metropolitan Area Planning Council, as well as with community partners GreenRoots, the Town of Arlington, and volunteers to help inform future climate resiliency planning around heat. The results of data taken in a summer 2021 heat wave demonstrate direct correlations between air temperatures and land use, race, and income within the Mystic River Watershed, with the hottest neighborhoods in Chelsea,

Somerville, East Boston, Everett, Revere, and Charlestown measuring up to 10 degrees hotter than the coolest areas in the watershed during heat wave events. The hottest recorded temperature was along Mystic Avenue in Somerville at 97.4 degrees with a heat index of 100.7 degrees.[31] Neighborhood temperature disparities highlighted in the Wicked Hot Mystic project correlated strongly with redlining maps, showing that Boston's communities of color are disproportionately more vulnerable to heat threats. The Wicked Hot Mystic data show that predominantly white neighborhoods can have as high as 43% tree cover versus just 2% tree cover in BIPOC (Black, Indigenous, and People of Color) neighborhoods like Chelsea, speaking to the need for greater tree equity, or equitable tree canopy cover, in our heat resilience planning.[32,33] The data also show that social isolation and lack of communications around extreme heat preparedness make certain residents particularly vulnerable. Through clear community participatory heat mapping and engagement in heat resilience solutions, the Museum of Science and its partners in the Wicked Hot Mystic project clearly demonstrate that our heat resilience solutions must operate within both a climate justice and racial justice framework that builds social resilience, by placing our historically excluded and disinvested communities of color and environmental justice communities at the center of our heat solutions.[34]

Transferable Heat Interventions

There are multiple opportunities to replicate the leadership of the Museum of Science and their partner organizations, including:

- Supporting participatory heat mapping and customized heat interventions informed by ongoing stakeholder engagement
- Establishing semi-permanent heat sensors on buildings and private property (including privately owned public spaces) to collect real-time data on temperature and air quality, providing additional context to lived heat experience by neighborhood and block
- Connecting bike networks to heat sensors for additional real-time heat data
- Tracking heat and air quality data over time to determine where heat interventions should be prioritized, establish baseline data, and determine whether such interventions are effective in mitigating heat over time

NON-PROFIT SECTOR: COMMUNITIES RESPONDING TO EXTREME WEATHER (CREW)

Project Location:

Boston (citywide), plus community hubs in Dorchester, Mattapan, South End, West End, and community heat resilience events within and beyond Boston

Lead:

Reverend Vernon Walker, Program Director at Communities Respond to Extreme Weather (CREW)

Project Highlights:

- Developing Climate Resilience Hubs
- Providing community-based heat resilience education, heat safety plans, and heat emergency communications
- Distributing cooling kits and other resources for immediate heat relief
- Improving social resilience and connectedness to enhance community heat resilience

Case Study Context

Communities Responding to Extreme Weather (CREW) is a community-based organization that is being incubated by the Better Future Project, a Cambridge, Massachusetts-based non-profit. With strong grounding in the Greater Boston community, CREW is a national leader in community-based and community-driven climate resilience work that is helping neighborhoods become more resilient in the face of extreme weather and temperatures across the country. Coordinating a national network of local leaders, CREW's mission is to help build grassroots climate resilience through inclusive and hands-on education, service, and learning. Their leadership is helping to provide communities and families with the resources, technical support, and capacity needed to prepare for and respond to climate change equitably, sustainably, and collaboratively.[35] CREW is helping to establish community resilience hubs and associated CREW teams in cities throughout the country, including in Boston. In the Commonwealth, CREW also serves as a member of the Massachusetts Voluntary Organizations Active in Disaster (VOAD). Through working to uplift local leadership, actively addressing historical and structural inequities in low-income, undocumented, and communities of color that are marginalized in climate decision-making, fostering long-term community education and social resilience, providing mutual community co-benefits, and collaborating across civic, public, and private sector stakeholders, CREW seeks to engage frontline communities in climate solutions through an emphasis on positive action, service, and relationship-building, grounded in community.

Some examples of CREW's leadership in fostering and empowering social connectedness as a core heat resilience strategy include:

- Intersectional panel discussions and CREW events like the Climate Preparedness Week 2022 talks and the 2022 Interfaith Summit where CREW helped communities think through participatory climate solutions with multiple co-benefits like social connectedness.[36]
- Community events in heat island environmental justice communities like Dorchester, Mattapan, and Brockton.
- In the summer of 2022, CREW hosted community events called "How to Stay Healthy in the Summer Heat" in the South End, Dorchester, and Mattapan. Physicians from Mass General Hospital and Boston Medical Center presented on how to avoid heat stress and stroke and where to go for heat relief. CREW raffled off free cooling kits, air conditioners, and tickets to the Museum of Science. Staff from Speak for the Trees spoke about opportunities to increase tree equity and tree canopy cover in partnership with the community, and staff from Resonant Energy discussed how to install subsidized solar panels and storage and provided resources to help with energy bills.
- A commissioned community study with

Tufts University looking at extreme weather and social connectedness in Chinatown and Grove Hall (Roxbury), to build upon work by the Conservation Law Foundation, and seek to measure, expand, and improve social connectedness and minimize social isolation in heat and other emergencies.

Project 1: Community-Based CREW Teams

CREW organizes groups of residents and volunteer community leaders who are interested in building community climate resilience through outreach, education, small-scale service projects, community-based events and programming, and participatory planning in CREW teams. In this way, residents and volunteers can help shape and advance collaborative and equitable heat resilience solutions at the individual, community, and state levels. If residents are interested in joining or starting a CREW Team in their community, then CREW will work with each pilot team to design and implement neighborhood resilience strategies and associated community engagement. Working with CREW staff and leadership, each CREW Team will have a customized plan specific to their neighborhood's needs, which could include actions like: de-paving and expanding green spaces and green infrastructure, hosting emergency heat response training in their community, and generating a participatory and community-driven resilience plan that promotes the safety, health, and well-being of all residents in extreme heat and weather. Staff at CREW continue to engage environmental justice and heat island communities extensively in their ongoing heat resilience outreach and are looking to build more CREW teams in the Greater Boston area.[37]

Project 2: Climate Resilience Hubs

CREW helps to establish and identify Climate Resilience Hubs that work alongside CREW Team volunteers. While CREW Teams leverage the expertise and lived experience of residents and community leaders to implement heat resilience plans, Climate Resilience Hubs can be tied to specific locations of community institutions like libraries, churches, schools, local businesses, and non-profit organizations, to help educate residents about extreme weather preparedness and the broader impacts of climate change on their community and health.[38] Once a place is designated as a Climate Resilience Hub, they are expected to display the Climate Resilience Hub decal in their window/door and have brochures and information available to their customers about climate preparedness and extreme temperatures. By establishing Memorandums of Understanding with each Climate Resilience Hub, CREW also asks each Hub to commit to additional service like adopting an equity-driven approach to climate resilience in their work, filling out annual surveys to help inform participatory planning, designating a point of contact for CREW, and other duties as agreed upon with the Hub organization. Hubs are encouraged to work with local emergency managers and community partners to help provide additional services needed to the community in heat wave events, which could include opening the Hub organization's or business' doors to provide cooling during heat emergencies, staying open later than usual during heat events, and having weather forecast information and additional resources readily available. As emergency services become increasingly strained in heat emergencies and extreme weather events, Climate Resilience Hubs are intended to help prepare local residents before heat emergencies occur and to help augment the limited capacity and support that emergency services and healthcare institutions can provide in heat emergencies. In addition to the actions mentioned above, Hubs may also help provide phone charging during power outages, organize welfare checks on vulnerable neighbors, or deliver other services as needed.[39] Some examples of Climate Resilience Hubs in Boston include the Mass Audubon Boston Nature Center and Wildlife Sanctuary (Mattapan), St. Stephen's Episcopal Church (South End), Old Cambridge Baptist Church (Cambridge), Old West Church (West End), and the Old South Church (Back Bay).[40]

Community Impact

CREW is looking to expand the model of Climate Resilience Hubs and is exploring 3 Levels of engagement: Level 1, Engagement Center; Level 2, Relief Station (under development); and Level 3, Shelter (to be determined). As described above, most existing Climate Resilience Hubs fall under Level 1 serving as outreach, education, and engagement centers for their community. CREW is seeking to build Level 2 Hubs that also serve as relief stations, providing direct

support to the local community during extreme heat events with resources such as providing air conditioning, electricity, phone charging, first aid, and a list of local resources. Developing these Level 2 Hubs would involve more targeted partnerships and activation with emergency managers and services. Finally, in the future, CREW hopes to look towards Level 3 Climate Resilience Hubs that would fulfill the functions of Levels 1 and 2 while also serving as an overnight, powered, supply-equipped emergency shelter during extreme weather events. This would involve a more formal, contractual connection to municipal emergency managers.

Transferable Heat Interventions

There are multiple opportunities to uplift and replicate CREW's work, including:

- Becoming a Climate Resilience Hub and working with CREW to disseminate heat resilience resources
- Helping to sponsor the distribution of resources like cooling kits, free water during heat emergencies, air conditioners, cool home interventions, and free tickets to cool spaces (ex. movie theaters or museums)
- Sponsoring CREW community heat resilience events in vulnerable heat island communities
- Helping to distribute heat resilience information, including distributing heat safety plans to your staff, maintenance crews, labor unions, and contractors, and ensuring clear communication of heat resources prior to and during heat emergencies
- Considering what additional resources your organization or business might contribute to heat vulnerable populations (ex. heat resilience programming for vulnerable residents like children, pregnant people, unhoused folks, and the elderly, financial support for the distribution of resources as mentioned above, and/or in-kind support from staff like physicians and heat resilience experts)

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