Community-Informed Heat Relief:

Policy Options for Addressing Urban Extreme Heat in High-Risk Communities

GEORGETOWN CLIMATE CENTER

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EXECUTIVE SUMMARY

Extreme heat causes more deaths than any other weather-related hazard.[1] As climate change causes temperatures to climb across the world, this threat to public health is only expected to worsen, and cities are among the places that are hardest hit. In Washington, DC alone, on average, a typical heat wave now lasts five days.[2] However, it is estimated that by 2050, the average heat wave will last 9.5 days, with areas affected by urban heat island conditions experiencing significantly higher temperatures than surrounding areas.[3] Due to the legacy of racially discriminatory redlining practices and long-term lack of investment in predominantly communities of color across the country, residents and workers in these areas are disproportionately exposed to high temperatures during heat waves.[4] Worse still, the COVID-19 crisis and resulting social distancing requirements have made some approaches to protecting residents from extended periods of high heat, like community cooling centers, more difficult to implement.

To better mitigate this public health threat, DC government agencies and the Georgetown Climate Center worked to engage members of the most affected communities in conversations regarding planning, investments, and policy decisions that affect health outcomes and the degree of health inequities. The purpose of this report is to inform a new comprehensive heat plan, which will direct DC government agencies on how best to aid frontline communities and populations most at-risk during heat waves and extreme heat crises.

Many local governments, including DC, have created Heat Emergency Plans to help their citizens adapt to and withstand periods of extreme heat.[5] However, the District government is exploring opportunities to create a larger vision for addressing extreme heat from multiple perspectives. This comprehensive heat plan will not only offer recommendations on how to update the emergency heat plan, but also cover additional topics like incorporating extreme heat considerations into building design and neighborhood development patterns.

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1   *Weather Related Fatality and Injury Statistics*, Nat'l Weather Serv. (2019), **https://www.weather.gov/hazstat/**.

2   Katharine Hayhoe & Anne Stoner, *Climate Change Projections for the District of Columbia*, DOEE (Apr. 2015), **https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/Attachment%201%20.ARC_. Report_07-10-2015.pdf**.

3   *Id.*

4   Kaitlin Sullivan, *Black, Latino, and Indigenous Communities Hit Hardest by Heat Waves*, Everyday Health (Oct. 8, 2020), **https://www.everydayhealth.com/healthy-living/black-latinx-and-indigenous-communities-hit-hardest-by-heat-waves/**; Meg Anderson & Sean McMinn, *As Rising Heat Bakes U.S. Cities, The Poor Often Feel It Most*, NPR (Sept. 3, 2019), **https://www.npr.org/2019/09/03/754044732/as-rising-heat-bakes-u-s-cities-the-poor-often-feel-it-most**.

5   *See, for example, New York City COVID-19 Heat Wave Plan*, Adaptation Clearinghouse (May 15, 2021), **https://www.adaptationclearinghouse.org/resources/new-york-city-covid-19-heat-wave-plan.html**; *Philadelphia, Pennsylvania Community Heat Relief Plan*, Adaptation Clearinghouse (July 2019), **https://www.adaptationclearinghouse.org/resources/philadelphia-pennsylvania-community-heat-relief-plan.html**.

This report provides an overview of the process used to engage District residents in discussions about existing city services relating to extreme heat, opportunities to improve upon those, and develop new services and initiatives that will help reduce heat-related risk for the residents most at risk. Informed by these discussions, the report then presents a range of policy options that the District could adopt or expand to better serve residents in times of extreme heat. Among the specific policy responses discussed in this report are:

- Communication and Outreach
- Cooling Centers
- Energy Efficiency Assistance
- Expanding Access to Air Conditioning
- Greening Initiatives
- Cool Pavements and Roofs
- Splash Parks and Water Access
- Temporary Housing Programs
- Mapping Heat Islands

For each policy option, the report includes a summary of relevant input from the community meetings and an overview of tradeoffs and potential barriers. It also identifies what DC is already doing related to the option and provides case studies from other cities illustrating how the policy option has been implemented in practice.

While this report was developed to help inform the District of Columbia's comprehensive heat planning process, the engagement process, policy options, and case studies discussed in this report provide useful examples for other cities looking to address extreme heat through a comprehensive plan.

URBAN HEAT AND PUBLIC HEALTH

Urban communities often record higher temperatures than their suburban counterparts because of the built-up nature of cities. For example, dark and impermeable surfaces like roofs and pavements absorb the sun's heat, contributing to higher urban temperatures. As natural landscapes are replaced by buildings, sidewalks, and parking lots, the amount of shade and natural cooling processes like evapotranspiration which are facilitated by green infrastructure, is reduced. Furthermore, the increased number of vehicles, factories, and air conditioning units within a city continuously emit heat, and tall buildings and narrow streets are more likely to trap hot air and cause reduced air flow.[6] *The elevated temperatures found within cities cause "urban heat islands" to form, resulting in temperature differences upwards of 7°F higher than outlying, more suburban areas.*[7]

Urban extreme heat creates dire public health threats, especially for certain populations and communities that are at higher risk for a variety of health, social, economic, or other reasons. Extreme heat, often referred to as a "heat wave," is an extended period of high temperature usually accompanied by high humidity.[8] Extreme heat kills by pushing the human body beyond its limits. In high heat and humidity, evaporation is slowed and the body must work much harder to maintain a normal temperature.[9] Increasingly frequent extreme heat events, along with other climate change impacts, have been directly related to negative health outcomes, such as aggravation of cardiovascular and respiratory disease, heat-related illnesses, and premature death. Certain populations are at a higher risk of heat-related illness or death, including those who work outside, older adults, children, people of color, lower-income families, and people experiencing homelessness. Extreme heat risk is affected by social, economic, and built environment factors that can cause or exacerbate underlying health conditions.[10] Additionally, lack of access to services and amenities that can mitigate heat risk, such as air conditioning or other in-home weatherization features, also often renders some of these populations more susceptible to heat-related illnesses.[11]

In the District, the Heat Emergency Plan is activated when the temperature or heat index reaches 95 degrees.[12] A heat index is "what the temperature feels like to the human body when relative humidity is combined with the air temperature."[13] The activation of the Heat Emergency Plan means that cooling centers throughout the District will be activated—the locations of which can be found on an Interactive Map on the Homeland Security and Emergency Management Agency **website**—and the Department of Human Services advises residents of the City to take a variety of precautions, including staying indoors, drinking water, and limiting exposure to the sun.[14]

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6   *Learn More About Heat Islands*, EPA (2017), **https://www.epa.gov/heatislands/learn-about-heat-islands**; *Urban Heat Islands*, UCAR (2021), **https://scied.ucar.edu/learning-zone/climate-change-impacts/urban-heat-islands**.

7   *Id.*

8   *Heat Waves: The Details*, Climate Commc'n (2021), **https://www.climatecommunication.org/new/features/heat-waves-and-climate-change/heat-waves-the-details/**.

9   *Climate Change Indicators: Heat-Related Deaths*, EPA (2014), **https://www.epa.gov/climate-indicators/climate-change-indicators-heat-related-deaths**.

10   Daniel Johnson, et al., *Socioeconomic Indicators of Heat-Related Health Risk Supplemented with Remotely Sensed Data*, 57 Int'l J. of Health Geographics 8 (2009).

11   *Id.*

12   *Heat Emergency Plan Information*, Homeland Sec. & Emergency Mgmt. Agency (2021), **https://hsema.dc.gov/page/heat-emergency-plan-information**.

13   *What is the Heat Index*, Nat'l Weather Serv. (2021), **https://www.weather.gov/ama/heatindex**.

14   *Heat Emergencies*, Dept. of Human Serv. (2021), **https://dhs.dc.gov/page/heat-emergencies**.

PARTICIPATORY PROCESS

The District of Columbia's Department of Energy and Environment (DOEE), MITRE, American Public Health Association (APHA) and the Georgetown Climate Center (GCC) partnered to engage local service providers and members from some of the communities most affected by extreme heat regarding planning, investments, and policy decisions that affect health outcomes, and the degree of health inequities around extreme urban heat. DOEE is working to use the outcomes of this engagement to inform the city's forthcoming comprehensive heat plan. In addition, DOEE issued an electronic survey to collect feedback on residential behavior during heat events regarding community knowledge and the use of government services. The survey was specifically designed and distributed to get a representative sample from various demographic groups and regions within the District. This work will help people in DC's most affected neighborhoods cope with extreme heat, using community engagement to develop values-based strategies and resources and make investments that enhance preparedness and urban heat adaptation.

Input from community members and service providers was gathered through a series of virtual meetings, as the engagement process was carried out in the midst of the COVID-19 pandemic. Many of the meetings were facilitated by a professional facilitator and environmental justice advocate. These facilitation services helped to ensure that the voices of service providers and community members would be heard first and foremost, with project leads taking a backseat and playing a listening role. Having a professional facilitator who deals primarily in equity issues can help to increase a community's confidence in any resulting plan or recommendations, as well as help with transparency. To encourage participation, those who attended the virtual discussions were given a $250 honorarium.

First, the partners held a virtual discussion to which local service providers were invited—primarily those who work with communities most susceptible to heat-related issues. These service providers included individuals from organizations such as So Others Might Eat (SOME), the Washington Legal Clinic, Catholic Charities, and more. During this meeting, project leaders asked that service providers recommend community leaders and residents of the most heat-affected wards, as well as seniors, public housing residents, and those who have or are experiencing homelessness, to engage in future virtual discussions.

Following the meeting with service providers, three additional virtual community discussions were held with individuals recommended by the service providers, so that DOEE and its partners could better understand directly from the community what was needed most in a new heat management plan. Meetings were held in the evening to help ensure that stakeholders who worked during the day were able to attend and offer opinions on the District's current heat plan, and brainstorm ways in which the new heat plan could better protect frontline residents. With the invitations to participate in the community discussions, project leaders also sent out a survey to collect information from residents. Survey questions included how important the participant believed extreme heat was to their community; where the survey taker was most likely to spend time during extreme heat waves (especially given the COVID pandemic); and if the individual was aware of any programs currently offered by the City that help residents stay cool. The last community discussion was held in Spanish to reach another heavily affected community in the District.

Through these virtual discussions, project leaders were able to engage local service providers and community members to hear about how they have dealt with extreme urban heat. Participants discussed a wide range of ideas for reducing heat risk, such as mapping heat waves, planting trees and developing "cool islands," creating a heat danger register (a self-declared list of people especially vulnerable to high temperatures who can register to receive phone check-ups, cooling advice, and medical help if necessary) and many other potential policy solutions. Policy Options that were emphasized by residents and service providers—which are examined further in this report—include:

- Communication and Outreach
- Cooling Centers
- Energy Efficiency Assistance
- Expanding Access to Air Conditioning
- Greening Initiatives
- Cool Pavements and Roofs
- Splash Parks and Water Access
- Temporary Housing Programs
- Mapping Heat Islands

The implications of COVID-19, which were heavily emphasized during the virtual discussions, are included within the analysis of each applicable policy option. Finding the balance between reducing COVID-19 exposure and preventing heat-related illnesses is difficult. Because any gathering of larger crowds has been discouraged, many of the traditional cooling mechanisms using public space where community members can congregate are not currently available. As a result, cities are struggling with how to help frontline communities withstand extreme heat. Many cities' greatest summer challenge has become how to enable the people who are most vulnerable to heat-related health problems to cool off without drastically increasing the risk of COVID-19—to which they too are more susceptible than other populations. With some of the following recommendations, the pandemic may present challenges for implementation. As such, other policy options discussed below concentrate on ensuring cooling options for individual households. It is also worth noting that according to stakeholder feedback, most indicated that they preferred to stay at home during heat waves. Therefore, focusing on safety and cooling options at home will continue to be valuable, even outside of the COVID-19 pandemic.

POLICY OPTIONS

The following section describes changes in policy or new programs that a government can implement to address urban heat issues within frontline communities. The policy options discussed below were suggestions made by community members during the stakeholder meetings. Each policy option contains a brief description of the policy, followed by an analysis of the current DC programs relating to that policy option. A table is included that analyzes some considerations policymakers may take into account when implementing each policy option. Each policy option section includes several case studies of instances and jurisdictions where these programs, projects, or policies have been implemented.

This list is by no means inclusive. However, policymakers should consider using these policies in conjunction with each other to help create a more effective urban heat plan, such that frontline communities are better prepared for and can better withstand extreme heat events.

Communication and Outreach

Facilitated community engagement meetings, pictured here, are an important component to communicating with community members about urban extreme heat. Credit: Georgetown Climate Center

Communication and outreach are key to ensuring that residents, especially those that are most susceptible to the effects of extreme heat, have the information and tools needed to take advantage of city programs and services related to heat mitigation. Outreach can provide residents with key information about the causes of increased heat, the health issues that stem from heat, and the existing policies and programs in place to assist and protect residents. Communication and outreach strategies in the District could take several different forms, such as direct outreach through phone calls, text alerts, mailings, and community meetings; passive outreach through flyers, posters, websites, and apps; establishment of "buddy" or check-in programs; development and training of heat ambassador teams; placing advertising at bus shelters and on the metro; and more.

Analysis

DC Programs

DC has several programs that alert residents to resources that are available during periods of extreme weather like heat and cold. The Emergency Heat Plan is activated by the Department of Human Services (DHS) and the Homeland Security and Emergency Management Agency (HSEMA) when the heat index within the district reaches 95°F.[15]

Residents can access an interactive **cooling map** on the government website that identifies where cooling centers are located throughout the District. Centers noted on the map include office buildings, spray parks, public housing for senior citizens, churches, indoor and outdoor pools, low barrier shelters, libraries, and recreation centers.[16]

There are also several services that residents can call or text if they do not have consistent access to the internet. Residents can reach HSEMA by calling (311) or texting (32311 to 311) to determine which recreation centers or public schools are open to escape the heat.[17] Additionally, HSEMA offers an alert program—once users sign up online, they will receive emergency notifications directly from public safety officials through email or by text.[18] A hotline also exists ((202)399-7093) that, when called, will connect people with transportation services to cooling centers.

Non-profit organizations also offer programs that alert residents about both heat waves and ways to cool down during them. For instance, So Others Might Eat (SOME) carries out wellness calls for older adults.[19] Private institutions can help fund cooling programs—such as cooling centers, cool pavements and roofs, etc.—but residents need to be made aware of these programs.

Considerations and Tradeoffs

Economic

- Costs associated with outreach and communication can vary widely depending on the type of approach implemented.
- Budgets for printed materials for certain agencies may be limited; as an alternative, social media can be used without significant cost.
- There are, however, costs associated with developing and operating an application that alerts residents about heat waves and the services provided for cooling and protecting vulnerable members of the community.
- Costs may also be associated with staffing programs (and training those staffers) that reach out to heat-susceptible residents during periods of extreme heat.

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15 *Heat Emergency Plan Information*, DC.gov (2021), **https://hsema.dc.gov/page/heat-emergency-plan-information**.

16 *Id.*

17 *Id.*

18 *AlertDC—Alerts Straight to Your Devices*, DC.gov (2021), **https://hsema.dc.gov/page/alertdc**.

19 *Senior Services*, SOME (2021), **https://www.some.org/services/social-services/senior-services**.

Environmental

- The more people that are aware of these types of programs—especially rebates and financial incentives for projects such as cool pavements and roofs, tree planting, etc.—the more people will participate in them.

- Each policy option listed in this memorandum lists the environmental benefits these programs can have. The more participants there are in these programs, the better the impact they will have on the environment.

Social/Equity

- Many of the programs that cities use to communicate with communities and frontline community members use electronic devices such as cell phones, computers, etc. However, lower-income households statistically have less access to these devices,[20] so it is important for cities to explore multiple outreach strategies that will reach residents with limited technological access.

- Even with these capabilities, some populations, such as older adults, may not know how best to utilize this type of technology.

- Program materials also need to be translated into other languages commonly spoken by residents so that non-native English speakers can understand and utilize the benefits associated with different urban heat programs.

Administrative

- Many lives can be saved by simply informing people about available programs. By equipping community members with knowledge regarding extreme heat, they, in turn, can be empowered to take action and generate more support within their own community to combat this issue.

- On the other hand, educating residents takes a significant amount of time and effort, with the benefits less immediately visible than other strategies such as A/C.

- It is often difficult to ensure that all of the residents in one community receive necessary information due to different personal preferences in how people receive knowledge. Furthermore, the current COVID-19 pandemic has rendered it unsafe to meet in large groups, and large-scale community meetings are not possible to implement at this time.

- Additionally, users may start to ignore alerts (texts, phone calls, etc.) if they receive too many. To help combat this, a tiered approach to alerts can be implemented.

- Different programs, such as direct outreach to neighbors and other community members, can help improve neighborhood cohesion.

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20   Monica Anderson & Madhumitha Kumar, *Digital Divide Persists Even as Lower-Income Americans Make Gains in Tech Adoption*, Pew Rsch. Ctr. (May 7, 2019), **https://www.pewresearch.org/fact-tank/2019/05/07/digital-divide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption/**.

Participant Commentary

Consistent concerns listed by several stakeholders:

- Stakeholders in every webinar made it clear that they had previously not been made aware of many of these programs;
- Wards 7 and 8 residents receive information slower than residents in other wards;
- Participants found websites confusing and difficult to find informational/educational material;
- Older adults may struggle with using technology; and
- There is a lack of informational material in any language other than English.

Other commentary:

- Several outreach strategies should be implemented simultaneously to reach applicable communities and individuals.
- The placement of educational advertisements in places like bus stops and metro stations should not be the only solution. Those with disabilities often do not use public transit, and thus may be less likely to be exposed to these materials.
- Service providers were aware they needed to develop better messaging to reach the broader community.

Potential policy or legislative solutions included:

- Receiving informational pamphlets via the postal service/mail;
- Providing information in an entertaining, user-friendly way, to make people want to learn about the subject;
- A heat advisory alert app that not only alerts residents to the heat wave, but also holds information about available District programs;
- Town halls, text alerts, and bus stop messaging;
- Strengthening the service provider network, especially to avoid community members getting "bounced around" between different providers;
- More calls to older adults living alone;
- Physical messages and material to communities, so as not to require internet access; and
- Using a multilingual approach in communication strategies so that more people can be reached.

Case Studies and Resources

Philadelphia, Pennsylvania Community Heat Relief Plan

The City of Philadelphia, Pennsylvania addresses extreme heat and social disparities in its *Beat the Heat Hunting Park Community Heat Relief Plan.* The plan provides a roadmap of how to conduct an inclusive climate planning process through a community-based approach to combat urban heat emergencies. To build trust and relationships, various community engagement strategies have been utilized throughout the planning process. Some strategies include forming a Hunting Park Heat Team with more than 30 government departments, community organizations and stakeholders; recruiting a team of resident Beat the Heat ambassadors; establishing a Beat the Heat Design workshop with over 40 residents to map out the cooling interventions; and building a Heat Relief Network by organizing existing faith leaders and community organizations in Hunting Park. Other engagement activities include holding Beat the Heat Kick Off parties and hosting an Environmental Wellness fair and tree giveaway. A Beat the Heat Mobile Station was also built to bring community awareness and provide heat-related information to the community.

Cool Neighborhoods NYC

New York City Mayor de Blasio launched *Cool Neighborhoods NYC* in June 2017. This $106 million program is designed to minimize the effects of extreme heat on the city by implementing projects such as cool roofs, city-wide tree plantings, and climate risk training for home health aides, among others. The comprehensive resilience program aims to reduce heat-related health impacts by lowering temperatures in heat-vulnerable neighborhoods and strengthening social networks as well. *Cool Neighborhoods NYC* is led by the Mayor's Office of Recovery & Resiliency and will be implemented in partnerships with NYC Parks, the Health Department, Small Business Services, Emergency Management, and members of the private sector. Specific programs and strategies include training home health aides on climate risks; educating New Yorkers about Be a Buddy NYC, which encourages neighbors to check on each other during heat waves; and building partnerships with reporters and agencies that work to alert residents about heat waves and offer cooling services.

Case Study: Scottsdale, Arizona's Cool Roofs Workshop

In 2015, the City of Scottsdale, Arizona hosted a Cool Roof workshop series, to promote the use of cool roofs as a strategy for increasing the energy efficiency of buildings and reducing urban heat islands. The workshop agenda consisted of a research scientist providing a "Cool Roofs 101" overview, discussing low-slope roofs, flat roofs, and cool roof membranes and coatings. A representative from a roofing company then presented on steep-slope roofs and energy efficient roof technology, design, and installation systems. The workshop also provided an overview of relevant stakeholder organizations and resources where attendees could learn more about current technologies to help reduce summer cooling costs and mitigate the urban heat island effect.

Cooling Centers
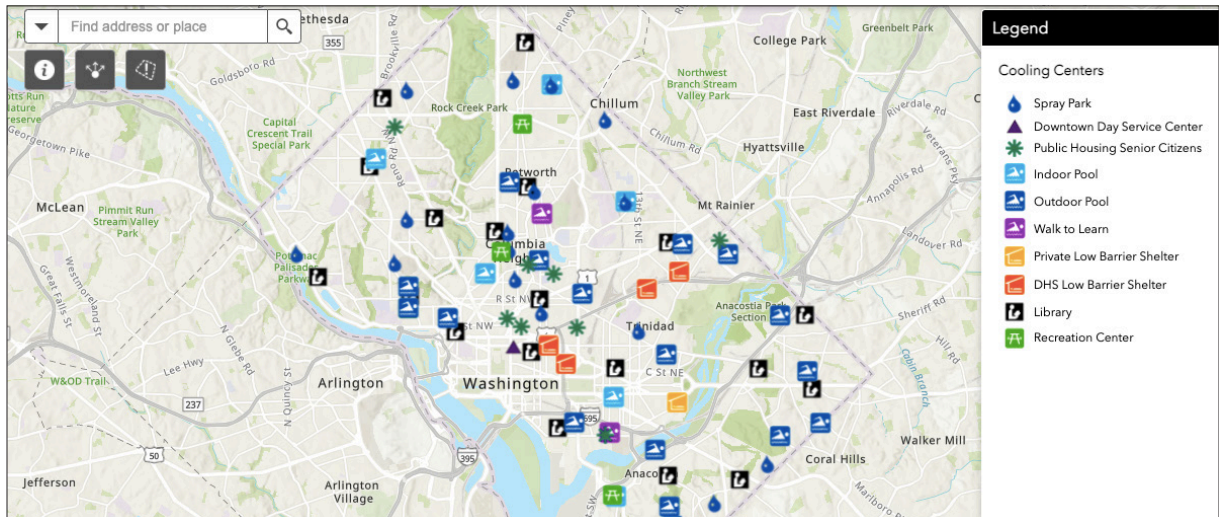
This interactive map, which can be found on the DC Heat Emergency Plan website and is maintained by the Homeland Security and Emergency Management Agency, shows the location and type of cooling centers in the District of Columbia. Address, hours of operation, and other information for each cooling center can be found by clicking each icon on the website. Credit: Homeland Security and Emergency Management Agency

Cooling centers are an important strategy in many cities to combat heat stress in populations that are at higher risk or may lack access to cooling opportunities at home or their place of work. Cooling centers are typically buildings that are open to the public and specifically designated as a safe space where individuals can go to escape extreme heat. They are usually "an air-conditioned or cooled building… [that] may be government-owned… such as a library or school, an existing community center, religious center, recreation center, or a private business such as a coffee shop, shopping mall, or movie theater."[21] They can also be outdoor locations, which offer amenities like spray parks or community pools. They can be run by government entities or agencies, churches, non-profits, businesses, or other private entities. Cities have had to navigate new challenges with cooling centers as a result of the COVID-19 pandemic, which has rendered these strategies that are based on public gathering spaces less safe unless additional precautions are taken.

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21   *Cooling Centers—District of Columbia*, Open Data DC (Aug. 11, 2020), **https://opendata.dc.gov/datasets/ bd51c0c373d844fa9654a7a02da23d6f**.

Analysis

DC Programs

DC's Homeland Security and Emergency Management Agency has developed a **Heat Emergency Plan**. When implemented, the Plan "activates" cooling centers for residents throughout the City who are seeking relief from extreme heat. The Emergency Heat Plan is activated by the Department of Human Services (DHS) and the Homeland Security and Emergency Management Agency (HSEMA) when the heat index within the district reaches 95°.[22] The Heat Emergency Plan website connects to an **interactive map** that identifies Cooling Centers throughout the City, which includes facilities like spray parks, office buildings, churches, indoor and outdoor pools, libraries, and shelters. Most recently, DC's government has decided to open 14 cooling centers around the District.[23]

COVID-19 has affected the operation of cooling centers around the City in an effort to control the spread of the virus. Specifically, in 2020, the District government did not allow summer meal distribution sites to be used for cooling purposes and closed pools and spray parks until further notice as well.[24] As of July 30th, 2020, no positive cases of COVID have been traced back to cooling centers.[25] In part, this may be because many members of the community are wary of using cooling centers in fear of contracting the virus. This fear was mentioned in both community discussions. Additionally, many people —especially women and older adults—mentioned the fact that they simply did not feel safe spending time in a cooling center.

Considerations and Tradeoffs

Economic

- Cooling centers are a less expensive way for a City to provide a cooling service for a large group of people during a heat emergency, rather than cooling down citizens household by household.

- Because cooling centers are often housed in already existing facilities with an established purpose, there may not be much—if any—cost associated with designating a facility as a cooling center.[26]

- Cities may want to develop vacant lots and/or condemned buildings into housing units, which will produce tax revenues, etc. In comparison, cooling centers are typically free for individuals to use, and likely will not produce significant revenue for the city. In many instances, cities must deal with these competing interests relating to a limited number of blighted or empty properties.

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22   *Heat Emergency Plan Information*, DC.gov (2021), **https://hsema.dc.gov/page/heat-emergency-plan-information**.

23   All Things Considered, *D.C. Opens 14 Cooling Centers Around the City*, NPR (July 30, 2020), **https://www.npr.org/2020/07/30/897344993/d-c-opens-14-cooling-centers-around-the-city**.

24   *Cooling Centers—District of Columbia*, Open Data DC (Aug. 11, 2020), **https://opendata.dc.gov/datasets/bd51c0c373d844fa9654a7a02da23d6f**.

25   Stasia Widerynski, The Use of Cooling Centers to Prevent Heat-Related Illness: Summary of Evidence and Strategies for Implementation, CDC Study, CDC (Aug. 7, 2017), **https://stacks.cdc.gov/view/cdc/47657**.

26   Seema G. Nayak, et al., *Accessibility of Cooling Centers to Heat-Vulnerable Populations in New York State*, 14 J. of Trnsp. & Health 1 (2019).

Environmental

- The purpose of cooling centers is to keep a group of people cool during periods of extreme heat, so the facility will necessarily be operating air conditioning unit(s). Although there are emissions associated with running an air conditioning unit (see the air conditioning section, below), these emissions are significantly less per cooling facility than those from homes operating individual air conditioning units.

- While there are emissions associated with operating an air conditioning unit, these costs may be offset by cooling multiple people in the same area at the same time.

- However, costs may increase as we continue to design HVAC systems for a warming world. To keep larger areas cooler, cooling systems may have to be oversized to keep up with demand.

Social/Equity

- Many frontline communities are experiencing gentrification, as developers are buying up properties to turn into high-rise condominiums or apartment living. As a result, community members are being pushed out of their homes due to rising costs of living and other displacement pressures.

- Any excess land or vacant buildings are also often being lost to development, rather than being utilized to build community cooling centers or other community amenities.

- Frontline communities typically have less access to public facilities that could serve as cooling centers. Grocery stores, schools, and health care facilities are less available in low-income neighborhoods and communities of color.[27]

- There is often a purchase requirement to enter into cooler spaces, such as a movie ticket, meal, etc. Places where entrance is free—like museums or libraries—are often not located in frontline communities.

- One of the populations most susceptible to heat related illnesses is the elderly. It may be difficult for these individuals to get to any cooling facility not directly in their vicinity.

Administrative

- These centers can also serve as a place to gather and receive information about continued dangerous weather conditions, connect with neighbors, and in some instances (depending on resources), shower, receive medical attention, etc.

- Residents of the community must be made aware that facilities like cooling centers are located within their area. Outreach is critical, as implementing and operating a cooling center for a community is only useful if there is broad awareness of its existence.

- This will likely involve some sort of educational program, as well as an interactive map to show where cooling centers are located. Educating the public about what cooling centers are and who is vulnerable may help increase utilization and save lives.[28]

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27 *Equitable Resources for Residents of Low-Income Neighborhoods and Communities of Color*, Local Hous. Sol., **https://www.localhousingsolutions.org/equitable-resources-for-residents-of-low-income-neighborhoods-and-communities-of-color/** (last visited Jan 19, 2021).

28 *Id.*

- From a city planning perspective, there may be competing interests relating to providing a cooling service for a community versus potential revenues related to commercial development. It may be difficult to transition away from planned development in the form of condominium or business construction in favor of cooling centers, which may not bring in the same amount of profit to the City.

- Other barriers to the implementation and use of cooling centers can include limited access to transportation, fear of leaving home or inability to leave home, not wanting to leave pets behind, populations not self-identifying as vulnerable, and the general stigma that cooling centers are for "old people."

- To combat this, cooling centers can offer additional, special programming during periods of extreme heat.

- COVID has highlighted a major limitation associated with cooling centers—that they serve as places to gather for multiple individuals during a time when gathering in larger groups is unsafe and/or prohibited.

- For a variety of reasons, individuals may not feel safe or comfortable leaving their homes and staying in a public cooling center for extended periods of time.

- The city or service provider of the cooling center may also need to provide transportation for frontline community members to a cooling facility.

Participant Commentary

Consistent concerns listed by several stakeholders:

- Places that are not traditionally "cooling centers"—including parking lots and other temporary spaces—have transitioned to hydration services during COVID to avoid group gatherings, but these spaces lack showers;

- Residents of these neighborhoods are unaware of the facilities that offer hygiene or shower options;

- Residents have not been to locate cooling centers or find information on what services they provide;

- Seniors want a place to "just hang out" that keeps them cool, but that's also safe for them as well—as of now, many were afraid to go to the cooling centers available to them;

- Cooling centers aren't open for long enough periods—stakeholders mentioned that many times, they are forced to leave cooling facilities because they close at night or on the weekends;

- Residents struggle to find ways to get to the cooling centers, especially during COVID; and

- Non-English speakers often have difficulty finding information regarding cooling centers because there is not sufficient educational material translated into other languages.

Other commentary:

- Catholic Charities has a year-round contract with the DC government for centers that prevent hypothermia and help to keep people warm during periods of extreme cold.[29]

- Currently, cooling centers are often inadequately resourced to address hygiene issues such as mold, or to ensure that they provide residents with clean showers and free hygienic supplies (such as menstrual products).

- While stakeholders wanted cooling centers to be safer and more welcoming towards elderly populations, they also agreed that populations experiencing homelessness have a right to stay cool as well.

- Some of the most visited cooling centers also offer additional services besides just air conditioning, such as activities for children and a pool/splash park.

- COVID has negatively changed the way that cooling centers operate—more recently, visitors have been given a cup of water and asked to leave after an extremely short period of time.

Potential policy or legislative solutions included:

- Ensuring that service providers develop cooling centers within walking distance of residents and neighborhoods that are the most in need;

- Keeping cooling centers open for longer, especially on weekends;

- Making sure that cooling centers are accessible for individuals with disabilities, such as people who are blind, low-vision, and hearing impaired;

- Maintaining public safety should be one of the main priorities of developing and operating a cooling center;

- Ensuring that cooling centers function only as cooling centers, i.e., they are not used concurrently as another type of facility, like a library;

- Providing safe, socially-distanced transportation to cooling centers;

- Transforming vacant lots and condemned buildings in frontline communities into green spaces or cooling centers, rather than more housing units; and

- Translating educational and informational materials into languages other than English.

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29 Will Espinoza, *What We Do and Who We Are: 24 Hours in the Life of a Shelter*, Cath. Charities (Apr. 23, 2019), **https://www.catholiccharitiesdc.org/life-of-a-shelter/**.

Case Studies and Resources

The Use of Cooling Centers to Prevent Heat-Related Illness: Summary of Evidence and Strategies for Implementation, CDC Study

In 2017, the Center for Disease Control (CDC) released their report, The Use of Cooling Centers to Prevent Heat-Related Illness: Summary of Evidence and Strategies for Implementation. According to the CDC, cooling centers are facilities that are usually air-conditioned and selected as a place to provide relief during periods of extreme heat. The Report analyzes how cooling centers have been implemented country-wide to offer best practices on how public health departments, non-profits, and government organizations can introduce cooling centers into their own communities. This analysis involves a breakdown of peer reviewed literature on cooling centers, a summary on the implementation and barriers to the development of cooling centers, and offers specific steps that policymakers and stakeholders should consider to overcome said barriers.

NYSERDA - Population Vulnerability to Climate Change in New York State

The New York State Energy Research and Development Authority (NYSERDA) identified current and future vulnerability to extreme heat across New York State, focusing on community and individual health risk factors. A heat-vulnerability index was developed, and a heat-health impact assessment was conducted using **ClimAID** climate projections. The study included an assessment of the adequacy and accessibility of cooling centers, and the public's awareness of cooling centers and heat warning systems or adaptation resources across New York.

Energy Efficiency and Clean Energy Assistance

Renewable energy—such as solar power—often lowers household energy costs as well as total GHG emissions.
Credit: National Renewable Energy Laboratory

The use of energy efficient appliances and clean, renewable energy to operate them can both directly and indirectly help to lower temperatures within urban heat islands. The energy needed to operate appliances like air conditioning units that keep people cool inside generates heat outside, directly contributing to rising temperatures within an urban heat island.[30] The more efficient an appliance or home is, the less direct heat it will generate when these appliances are in use. Indirectly, the use of energy efficient appliances and renewable energy sources in general will help to reduce GHG emissions, which contribute not only to rising temperatures within city centers, but the world as a whole.

Cities can use weatherization programs to help facilitate the transition in lower-income communities to efficient appliances and renewable energy sources. This process typically involves making the homes of families who qualify— lower-income and often those on the frontlines of climate change—more energy efficient with little to no cost to the resident.[31] To help finance these transitions, the U.S. Department of Energy offers funding through its Weatherization Assistance Program (WAP), which is typically distributed by a State's energy or environmental agency to help these

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30   Zach Reese, *Solving the Problem of Urban Heat Island Effect on an Individual Level,* Colony Roofers (Oct. 20, 2021), **https://www.colonyroofers.com/solving-the-problem-of-the-urban-heat-island-effect-on-an-individual-level/**.

31   *Reducing Urban Heat Islands: Compendium of Strategies—Heat Island Reduction Activities*, EPA (2008), **https:// apo.org.au/sites/default/files/resource-files/2008-10/apo-nid181566_34.pdf**.

residents cover the cost of purchase, installation, and operation.[32] WAP funding can also be used to provide applicants with access to renewable energy, though the applicable government agency must apply through the Weatherization Grantee Renewable Energy Technology Application to do so.[33] The Federal Government also offers several additional programs that encourage the installation and use of renewable energy resources. These include financial incentives, regulatory policies, grant programs, tax credits, and more.[34]

Essentially, these types of programs reduce the cost burden associated with energy usage for lower-income residents, and make the purchase of renewable energy and energy efficient technology more feasible for these communities.

Analysis

DC Programs

The District government has several energy efficiency programs for low-income families and households. In 2008, the DC City Council adopted the Clean and Affordable Energy Act (CAEA), authorizing the DOEE to contract with a DC sustainable energy utility to implement energy efficiency programs.[35] The CAEA creates an energy assistance trust fund, allocating $3.3 million annually to existing programs, and a Residential Aid Discount subsidy for $3 million annually.

WAP funds, administered by the DOEE through community-based organizations and non-profits, supplies funding to local contractors to install energy efficient measures—including insulation, energy efficient heating and cooling systems, and ENERGY STAR appliances—in low-income residences.[36] To be eligible, applicants must first qualify for the DOEE's Low Income Home Energy Assistance Program (LIHEAP). Applications for qualification for WAP will reopen on October 1, 2021.[37]

A list of programs available to DC residents that will facilitate the increase in energy efficiency and the use of renewable energy resources can be found **here**.

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32   *Id.*

33   *Preliminary Assessment Guide for Integrating Renewable Energy into Weatherization*, U.S. Dept. of Energy (2019),
      https://www.energy.gov/sites/prod/files/2019/05/f63/CELICA-Brief-WAP-Renewables.pdf.

34   *Federal Programs*, DSIRE, **https://programs.dsireusa.org/system/program?state=US** (last visited Mar. 15, 2021).

35   *Guidelines for Low-Income Energy Efficiency Programs*, Am. Council for an Energy-Efficient Econ. (2020),
      onemedical.com.

36   *Weatherization Assistance Program (WAP)*, Dept. of Energy and Env't (2021), **https://doee.dc.gov/service/
      weatherization-assistance-program-wap**.

37   *Id.*

Considerations and Tradeoffs

Economic

- The federal government offers several programs to help lower-income households afford their energy bills during extreme weather events like heat waves or cold snaps. For example, the U.S. Department of Energy has a Weatherization Assistance Program, which works "to increase the energy efficiency of dwellings owned or occupied by low-income persons, reduce their total residential energy expenditures, and improve their health and safety, especially low-income persons who are particularly vulnerable, such as the elderly, the disabled, and children."[38]

- The DOE Weatherization Program contracts with states, tribes, and local governments—currently around 700—to hire in-house crews and private contractors to retrofit low-income households with energy-efficient technology.[39]

- Another example of a federal energy efficiency program is the Low-Income Home Energy Assistance Program (LIHEAP) which provides funding assistance for home energy bills, energy crises, and weatherization and energy-related minor home repairs.[40]

- Most states offer several incentive and/or funding programs for low-income households to retrofit their homes with more energy-efficient technology. For a full list of programs, see the American Council for an Energy Efficiency Economy's **website**.

- Studies have found that once energy efficiency technology has been installed in a home, "the total cost of saving electricity — both the cost to the utility or other program administrator (and thus to the utility's ratepayers) and the cost to the utility customer participating in the efficiency program (who buys an energy-efficient product or service and gets a price discount or other benefit from the program) — is 5¢ per kWh, split almost evenly between the program administrators and participating customers."[41]

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38 *About the Weatherization Assistance Program*, Off. of Energy Efficiency & Renewable Energy, **https://www.energy.gov/eere/wap/about-weatherization-assistance-program** (last visited Jan. 21, 2021).

39 *Id*.

40 *Low Income Home Energy Assistance Program (LIHEAP)*, Off. of Cmty. Serv., **https://www.acf.hhs.gov/ocs/low-income-home-energy-assistance-program-liheap** (last visited Jan. 21, 2021).

41 *The Cost of Saving Electricity Through Energy Efficiency Programs Funded by Utility Customers: 2009-2015*, Berkeley Lab (Jun 27, 2018), **https://emp.lbl.gov/news/cost-saving-electricity-through-energy**.

Environmental

- Increased energy efficiency can help residents use less electricity to power their homes, lowering greenhouse gas emissions "and other pollutants, as well as decreas[ing] water use."[42]

- Residential energy efficiency can have significant GHG reduction benefits. For instance, if every household in the country swapped a traditional bulb with an energy efficient one, it would be the same as taking 1.3 million cars off the roads.[43]

- Considering current technology, the US has the potential to cost-effectively reduce electricity needs by 16% by 2035.[44]

- The use of energy efficient and renewable energy technologies can help conserve the limited finite resources we have, like coal, trees, natural gas, etc.[45]

Social/Equity

- Weatherization programs can create economic opportunities for low income neighborhoods and communities. The Federal Weatherization Assistance Program (WAP) created energy efficiency training programs to train low-income community members to install and maintain these technologies. It also uses American-made products and local contractors, "benefitting the business community in the regions they serve."[46]

- Weatherization programs can have several benefits for low income families. They make homes more livable and help to spur economic growth within communities. For every $1 invested in the program, weatherization returns $2.78 in non-energy investments alone.[47]

- On average, weatherized households can save $283—or more—annually.[48]

- Eligibility for the programs depends on household income and family size.

- Because many of the funding programs are federal, it may be difficult for individuals who are undocumented to access these opportunities.

- Many frontline communities may not be aware of the available programs in their areas. Educational materials surrounding these programs may only be in English, and are often found online—and frontline community members may not have access to the resources they need to learn about them.

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42 *Local Energy Efficiency Benefits and Opportunities*, EPA, **https://www.epa.gov/statelocalenergy/local-energy-efficiency-benefits-and-opportunities#:~:text=Environmental%3A%20Increased%20efficiency%20can%20lower,well%20as%20decrease%20water%20use.&text=Risk%20Management%3A%20Energy%20efficiency%20also,associated%20with%20fluctuating%20fuel%20prices** (last visited Jan. 21, 2021).

43 *How Does Saving Energy Help the Environment*, Save on Energy, **https://www.saveonenergy.com/learning-center/energy-saving-tips/how-does-saving-energy-help-the-environment/** (last visited Jan. 21, 2021).

44 *Energy Efficiency: Savings Opportunities and Benefits*, Off. of Energy Efficiency & Renewable Energy, **https://www.energy.gov/eere/slsc/energy-efficiency-savings-opportunities-and-benefits** (last visited Jan. 21, 2021).

45 *Id.*

46 *Id.*

47 *About the Weatherization Program, supra* note 38.

48 *Weatherization Works*!, U.S. Dept. of Energy (2019), **https://www.energy.gov/sites/prod/files/2019/07/f64/WAP-Fact-Sheet-2019.pdf**.

Administrative

- Cities can adopt zoning ordinances or create building codes that require new construction to install energy efficient appliances and/or renewable energy infrastructure.

- The use of both energy efficient appliances within a home and renewable energy sources to power them can help to lighten the impact/load of the home on the area's electric grid during periods of extreme heat. This can help to ensure a more reliable supply of power to the community at large.[49]

- Many District programs are not widely known and the process of applying for these programs is not easily accessible to those most in need. Most importantly, many of these existing programs are no longer taking applications or funds have dried up.

- "Many states and local organizations leverage other federal, state and private WAP programs to deliver more services while inside the home."[50]

- Participants in many of these types of programs also become eligible for other programs as well, including, but not limited to home energy kits; workforce development programs; financial training programs; and more.

- Under the Coronavirus Aid, Relief, and Economic Security (CARES) Act, states were allocated $900 million in additional funding to help applicants and participants in the program through the federal LIHEAP program due to COVID.[51]

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49 *What You Can Do to Reduce Heat Islands, EPA (2020),* **https://www.epa.gov/heatislands/what-you-can-do-reduce-heat-islands**.

50 *Id.*

51 *LIHEAP DCL 2020-10 CARES Act Supplemental Funding Release FFY20*, Office of Comm. Serv. (May 8, 2020), **https://www.acf.hhs.gov/ocs/policy-guidance/liheap-dcl-2020-10-cares-act-supplemental-funding-release-ffy20**.

Participant Commentary

Consistent concerns listed by several stakeholders:

- Residents are not adequately informed about the existence of the programs offered by the District related to energy efficiency; and

- It has been difficult to sign up for incentives, funding, etc.

Potential policy or legislative solutions included:

- The creation of expansive education programs geared towards informing frontline communities about the existence of these programs, and assistance with signing up for them; and

- Translating education materials into languages other than English.

The biggest issue participants had with the programs offered by the District related to energy efficiency was that they were not adequately informed of the programs' existence. One resident in the first meeting said that the "city [was] failing to help people utilize… programs that could help cool their houses," primarily because people don't know how to sign up for incentives, funding, etc. A few mentioned feeling "cheated." To help combat this, one resident even stated they were running for office to spread information more widely about the resources.

Case Studies and Resources

Solar Works DC

In 2017, the District of Columbia's Departments of Energy & Environment (DOEE) and Employment Services (DOES) partnered with GRID Alternatives Mid-Atlantic to start Solar Works DC, to implement a low-income solar installation program with a job training component. The purpose of the Program is to focus on training disadvantaged members of the DC community in solar installation, and provide low-income families with solar energy systems. Over a three-year period, more than 200 individuals have been trained in solar-related related industries. They have assisted with the installation and maintenance of 300 solar systems on low-income, single-family homes within the District.

Enhancing Community Resilience through Energy Efficiency

Enhancing Community Resilience through Energy Efficiency, produced by the American Council for an Energy-Efficient Economy, evaluates the effectiveness of energy efficiency as a resiliency strategy. This report aims to aid local governments, businesses, and community decisionmakers in assessing risk, and integrating energy efficiency into resilience planning. The report provides guidance for local governments looking to incorporate energy efficiency into their community's resilience planning by examining current efforts made by local governments of varying size. It provides examples of cities that initiated their own planning processes, as done in Boston, San Francisco, and New York. The report also recognizes that not all communities address this alone, and provides examples of places that are leveraging federal programs such as the Sustainable Communities Initiative grant program. For energy resiliency, the report suggests that energy assurance plans (EAPs) are an effective way to plan for climate change, and have been used by cities like Denver and Portland. Hazard mitigation plans and partnerships with utilities are other promising avenues.

Retrofit Chicago

Retrofit Chicago is a cross-sector effort Led by the Mayor's Office to drive energy efficiency in municipal, commercial, and residential buildings across the city, saving money, reducing carbon emissions, and creating jobs. The Residential Partnership unites non-profit groups and utility companies to connect residents to energy retrofit contractors, free energy upgrades, and equipment rebates. Customer benefits include free energy assessments with free energy-saving products and installation; rebates for energy efficient appliances and other products; financing tools such as income qualifying grants for bungalow & vintage homeowners, energy savers loans, and on-bill financing and connect to qualified contractors.

Maryland Office of Home Energy Programs: Energy Assistance

The Office of Home Energy Programs (OHEP) provides bill assistance to low-income households in the State of Maryland to make their energy costs more affordable and to help with the prevention of loss and the restoration of home energy service through several programs. The Electric Universal Service Program (EUSP) provides financial assistance with electric bills by providing eligible customers help that pays a portion of their current electric bills. Customers who receive EUSP are placed on a budget billing plan with their utility company. Budget Billing is a tool that utility companies provide to help spread out annual utility bills into even monthly payments to avoid spikes caused by seasonal fluctuations in energy use. The Arrearage Retirement Assistance helps customers with large past-due electric and gas bills. If eligible, customers may receive forgiveness of up to $2,000 towards their past-due bill. Customers must have a past due bill of $300 or greater to be considered eligible. Customers may only receive an arrearage grant once every seven years, with certain exceptions.

Expanding Access to Air Conditioning
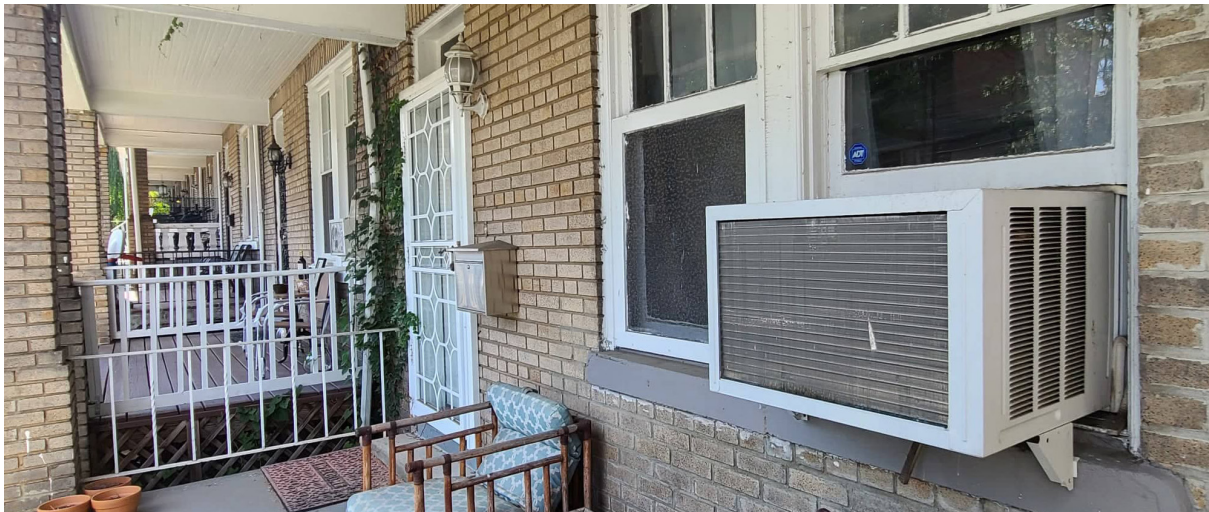
Air conditioning units, such as these pictured in Northeast Washington, DC, provide immediate heat relief for residents during periods of extreme heat. Credit: Georgetown Climate Center

As illustrated by the commentary below, many frontline community members have an immediate need for heat-relief. This heat-relief can come in the form of air conditioning (A/C), which can be provided in the form of central A/C in vents or through window units. This section identifies actions that city governments could take to help expand access and affordability of A/C, particularly for residents most in-need, such as those in substandard housing or facing challenges regarding the cost of energy. These include, for example, programs that provide units directly to priority residents that meet certain criteria, and programs designed to assist with energy costs of running A/C units.

Analysis

DC Programs

The Emergency Heating, Cooling, and Air Conditioning (HVAC) Program is facilitated by the DOEE and the DC Sustainable Energy Utility (DCSEU). The Emergency HVAC Program works to repair and replace broken heating and air conditioning systems for eligible seniors and people with disabilities who own or rent their home.[52] Another

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52   Ben Burdick, *Keeping DC Cool with the Emergency HVAC Program*, DC Sustainable Energy **https://www.dcseu. com/news-blog/news-blog/blog-posts/keeping-dc-cool-with-the-emergency-hvac-program** (last visited Mar. 2,

relevant program for residents who already have air conditioning units installed is the Low-Income Home Energy Assistance Program (LIHEAP). This program provides households with a one-time energy assistance benefit between $250 and $1,800.[53] Residents can additionally reduce their utility costs through the Utility Discount Program (UDP).[54]

While A/C is one of the most effective forms of heat-relief for residents, cost is a major barrier, especially as rising temperatures result in increased usage of electricity. While programs such as LIHEAP and UDP exist to combat this issue of affordability, the community meeting discussions seem to indicate that many residents are unaware of the programs. Any city strategy to expand access to or improve affordability of A/C should therefore be paired with robust outreach to residents.

Considerations and Tradeoffs

Economic

- There are several costs associated with using an A/C unit for cooling purposes, including the initial investment, consistent maintenance and occasional repairs, and electricity charges associated with actually running the unit.

- Urban heat islands increase temperatures within cities, meaning that units within urban communities will likely need to run more often and at lower temperatures to keep households cool—resulting in higher energy costs.[55]

- Keeping an A/C unit running during periods of extreme heat can be incredibly expensive. A recent study found that some households can spend between 35% and 42% of household income on electricity to run an A/C unit.[56]

- Low-income households also pay more for energy per square foot because they typically own less efficient appliances and because their homes are less weatherproof.

2021).

53 *Receive Discounts on Your Utility Bills (LIHEAP),* DOEE, **https://doee.dc.gov/liheap** (last visited Mar. 2, 2021).

54 *Receive Discounts on Your Utility Bills (UDP),* DOEE **https://doee.dc.gov/udp#:~:text=The%20Utility%20 Discount%20Programs%20** (last visited Mar. 2, 2021).

55 Karin Lundgren-Kownacki, *Challenges of Using Air Conditioning in an Increasingly Hot Climate*, 62 Int'l J. of Biometeorology 401 (Dec. 30, 2017).

56 Emma Charlton, *How Air Conditioners Contribute to Inequality and 'Energy Poverty',* World Econ. F. (July 6, 2020), **https://www.weforum.org/agenda/2020/07/air-conditioners-inequality-energy-poverty-climate-change/**.

Environmental

- The energy that is necessary to keep A/C units running contributes to climate change, which in turn worsens the climate crisis that is the root cause of increased heat stress.

- An IEA report found that by 2050, A/C usage across the world could produce up to 2 billion tons of carbon emissions a year, given the current efficiency of the units.[57]

Social/Equity

- According to a University of California, Berkeley study, people of color were over 50% more likely than Caucasians to live in communities with greater heat risks and less shade vegetation.[58]

- Poor roofing and less foliage, which are more typical in urban areas, lead to urban heat islands and increasing temperatures. Studies have shown that lower income households in more urban areas are more likely to be unable to afford the purchase or running of A/C units for extended periods of time at these increased temperatures.[59]

- Lower-income households are also less likely to work in an air-conditioned environment.[60]

Administrative

- If an A/C unit is not effectively installed or functioning in the proper place within a home, it can be an ineffective way of cooling an entire apartment or home. Single units may cool only one part of the apartment or house, causing residents to strategize where to place them and when to run them.

- Local governments or agencies can require that certain housing units—like low income housing—have A/C units installed, and that the City (or applicable agency) pay for part of the utility bills associated with keeping these units running during periods of extreme heat.

- If all units in an apartment building or housing development run all of their air-conditioning units at once, power outages may occur.

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57   The Future of Cooling, IEA (May 2018), **https://www.iea.org/reports/the-future-of-cooling**.

58   Bill Jesdale, Rachel Morello-Frosch, & Lara Cushing, *The Racial/Ethnic Distribution of Heat Risk-Related Land Cover in Relation to Residential Segregation*, 121 Envtl. Health Perspectives 881 (July 1, 2013); Amy Fleming, *Heat: The Next Big Inequality Issue*, The Guardian (Aug. 13, 2018), **https://www.theguardian.com/cities/2018/aug/13/heat-next-big-inequality-issue-heatwaves-world**.

59   Lundgren-Kownacki, *supra* note 55.

60   *Id.*

Participant Commentary

Consistent concerns listed by several stakeholders:

- Lack of and/or inconsistency of air conditioning in their homes;

- Cost of air conditioning units and cost of air conditioning operation;

- Inability of units to cool entire apartment or circulate air; and

- Units shutting off due to high demand, especially during extremely hot periods and during the day.

Other commentary:

- Many of the residents in the meetings stated that they relied on air conditioning units to stay cool, despite issues associated with their purchase and operation.

- A lack of air conditioning units can lead residents to stay with other family members, which may be difficult due to COVID.

- During periods of extreme heat, working outdoors does not allow for much access to A/C during the work-day.

- In some instances, residents experienced landlords charging residents for additional A/C units, even when the one that was provided was not functional enough to circulate air for entire families.

Potential policy or legislative solutions included:

- Mandating that landlords provide air conditioning to residents; and

- Government subsidies for air conditioning operations during heat emergencies.

Case Studies and Resources

New York City COVID-19 Heat Wave Plan

In May of 2020, New York City (NYC)'s Mayor Bill de Blasio announced a COVID-19 Heat Wave Plan to keep vulnerable New Yorkers cool at home, create safer summer cooling options, and anticipate and reduce power outages. The plan addresses the higher risk for indoor summer heat exposure that vulnerable residents face while simultaneously trying to maintain social distancing in the context of a global pandemic. The $55 million plan directs the City to install 74,000 air conditioning units in the homes of residents who are 60 years of age or older, retrofit new spaces for emergency cooling centers, and better prepare for power outages. Those that are eligible for new air conditioning units are New Yorkers who are 60 years of age or older, make below 60 percent of the state median income, and do not have A/C at home. By June of 2020, the City had already reached out to over 180,000 low-income seniors and had installed over 4,500 A/C units, including 1,900 in NYCHA buildings. Additionally, the New York State Public Service Commission will provide $70 million in funding to help pay the utility bills of approximately 440,000 NYC families so that they will not have to choose between paying for air conditioning and other necessities. The City is also advocating for the state to allocate a portion of the $900 million Home Energy Assistance Program funding it received through the CARES Act for summer utility bill relief and to compensate for some of the increased energy usage with A/C installations. The plan lessens risk for vulnerable NYC residents of heat-related illnesses and death, as well as COVID exposure or infection.

Resilient Rhody: An Actionable Vision for Addressing the Impacts of Climate Change in Rhode Island

Resilient Rhody is the state of Rhode Island's first climate adaptation strategy to address the impacts of climate change to the state's critical infrastructure and utilities, natural systems (upland and coastal), emergency preparedness, and community health and resilience. One of the six principles guiding the strategic actions developed for *Resilient Rhody* focuses on equity - *'Equitably reduce the burden of climate change impacts with particular attention to environmental justice communities across the state.'* This strategy addresses amplified impacts on vulnerable communities and in particularly increasing heat. The plan recommends expanding the state's Low Income Home Assistance Program to help eligible residents pay for their air conditioning.

North Carolina Climate and Health Profile: Building Resilience Against Climate Effects

North Carolina is one of 16 states funded by the Center for Disease Control and Prevention (CDC) Building Resilience Against Climate Effects (BRACE) grant program since 2010. As part of the BRACE framework, this *Climate and Health Profile* report describes the leading climate-related risks and their associated public health impacts in the state. As discussed in the report, the North Carolina Department of Health and Human Services has been involved in multiple health assessments and interventions to address adverse weather and climate impacts on public health. For example, the Division of Aging and Adult Services has led efforts to deal with extreme heat through Operation Fan Heat Relief since 1986, distributing fans and air conditioning units to adults with disabilities and those over the age of 60 during the summer months.

Greening Initiatives

Tree planting is one of many important greening initiatives that go towards reducing the impact of urban extreme heat by increasing and restoring tree canopy. Photographed here, Casey Trees, a DC-based nonprofit, encourages businesses, residents, and communities to plant trees through financial and planning assistance. Credit: Casey Trees

Between 1990 and 2016, the world lost over 500,000 square miles of trees and tree canopy.[61] Consistent with this global trend, many cities are losing their tree cover, especially in frontline communities, making these areas hotter. For example, in Louisville, Kentucky, 54,000 trees a year are lost to development, natural disasters, disease, and lack of care.[62]

Tree canopy and the existence of green infrastructure can have significant positive effects on urban heat island temperatures. The EPA has found that trees, vegetation, and greenery lower temperatures by providing shade and contributing to evaporation, which can make the air in an area less humid.[63] Plants also release water vapor that can help to decrease temperatures—a process known as evapotranspiration.[64] Shaded areas can be between 20° to 45°F cooler than unshaded areas, whereas evaporation can help reduce humidity and temperatures between 2° to 9°F. Trees can also return heat back to the atmosphere faster than concrete, and don't store as much warmth.[65]

61   Christina Nunez, *Deforestation Explained*, Nat'l Geographic (Feb. 7, 2019), **https://www.nationalgeographic.com/ environment/global-warming/deforestation/#:~:text=Between%201990%20and%202016%2C%20the,study%20 in%20the%20journal%20Nature**.

62   Meg Anderson, *Trees are Key to Fighting Urban Heat—But Cities Keep Losing Them*, NPR (Sept. 4, 2019), **https:// www.npr.org/2019/09/04/755349748/trees-are-key-to-fighting-urban-heat-but-cities-keep-losing-them.**

63   *Using Trees and Vegetation to Reduce Heat Islands*, EPA, **https://www.epa.gov/heatislands/using-trees-and- vegetation-reduce-heat-islands#:~:text=Trees%20and%20Vegetation%20Resources&text=Trees%20and%20 vegetation%20lower%20surface,peak%20temperatures%20of%20unshaded%20materials** (last visited Mar. 8, 2021).

64   Sarah DeWeerdt, *When Adding Green Space Reduces Urban Heat—And When It Doesn't,* Daily Sci. (Sept. 17, 2019), **https://www.anthropocenemagazine.org/2019/09/the-solution-to-urban-heat-is-not-one-size-fits-all/**.

65   Nathalie Shanstrom, *New Research on the Impact of Trees on the Urban Heat Island Effect*, Deeproot (Apr. 18, 2016), **https://www.deeproot.com/blog/blog-entries/new-research-on-the-impact-of-trees-on-the-urban-heat-island-**

Cities can help reduce heat through targeted urban greening and urban forestry programs that focus investments in neighborhoods with a higher urban heat island effect due to less tree cover and higher proportion of impervious surfaces. The use of trees and vegetation near facilities can even reduce the need to use air conditioning units within buildings. As a whole, nationwide, "city trees already prevent approximately 1,200 heat-related deaths and countless heat-related illnesses annually."[66]

Analysis

DC Programs

The 2013 District of Columbia Tree Canopy Plan established a goal of 40% healthy tree canopy coverage in the District by 2032.[67] To reach this goal, the District will have to plant at least 10,850 trees per year.[68] As of January 20, 2021, the District has only three percent left to go, equating to about 2,300 acres over the next 17 years.[69] For the past five years, the District's work in tree planting has earned an A+ from Casey Trees, a local nonprofit focused on tree canopy restoration and protection in the District. To encourage planting, Casey Trees also offers rebates to residents and homeowners—up to $100 for every tree planted on private property.

Additionally, through Casey Tree's Community Tree Planting Program grant, businesses and communities are offered competitive funding when they plant ten or more trees. Included in this funding are the trees themselves, as well as any necessary assistance to determine where trees should be planted and to plant the trees themselves.[70] Other initiatives funding tree planting include the RiverSmart Homes Program and the Watts Branch Upland Tree Planting Initiative.[71]

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effect.

66   *What is the Urban Heat Island Effect?*, Am. Forests, **https://www.americanforests.org/af-news/what-is-the-urban-heat-island-effect/** (last visited Jan. 13, 2021).

67   *Trees in the District*, DOEE, **https://doee.dc.gov/trees** (last visited Jan. 20, 2021).

68   *Id.*

69   *Canopy 3000*, DOEE, **https://doee.dc.gov/service/canopy-3000** (last visited Jan. 21, 2021).

70   *District of Columbia Urban Tree Canopy Plan*, DOEE (2013), **https://doee.dc.gov/sites/default/files/dc/sites/ddoe/page_content/attachments/Draft_Urban_Tree_Canopy_Plan_Final.pdf**.

71   *Id.*

Considerations and Tradeoffs

Economic

- "Healthy trees help reduce utility costs—nearly $7.8 billion [is] saved annually from energy bills for homes, from small towns to metro areas in the U.S., due to trees blocking wind and providing shade."[72]

- Annual costs of planting trees—depending on the number of trees planted and where—range from $15 per tree in the Desert Southwest to $65 per tree in Berkeley, CA.[73]

- Pruning is typically the greatest cost associated with tree planting, ranging between $4 to $20 per tree. It is important to note that maintenance jobs can go to members of the neighborhoods where they are being planted, creating economic opportunities in frontline communities.[74]

- "Although the benefits of urban forestry can vary considerably by community and tree species, they are almost always higher than the costs. [A] five-city study … found that, on a per-tree basis, the cities accrued benefits ranging from about $1.50–$3.00 for every dollar invested. These cities spent roughly $15–$65 annually per tree, with net annual benefits ranging from approximately $30–$90 per tree."[75]

Environmental

- Planting trees can help improve the environmental aspects of the community, in addition to lowering temperatures. For example, shade brought by trees can help decrease temperatures indoors, meaning that air conditioning units have to run less often. The reduced need for air conditioning results in less air pollution and better air quality.[76]

- Trees can also absorb air pollutants, as well as store and sequester carbon dioxide from the atmosphere.[77]

- Trees and vegetation can help with stormwater management and improve water quality. Root systems can reduce stormwater runoff by absorbing and filtering rainwater.[78]

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72   *Tree Equity in America's Cities*, Am. Forests, **https://www.americanforests.org/our-work/urban-forestry/** (last visited Jan. 19, 2021).

73   *Using Trees and Vegetation to Reduce Heat Islands*, EPA (2005), **https://www.epa.gov/heatislands/using-trees-and-vegetation-reduce-heat-islands#:~:text=The%20use%20of%20trees%20and,mitigating%20urban%20heat%20islands%20including%3A&text=Improved%20air%20quality%20and%20lower,pollution%20and%20greenhouse%20gas%20emissions**.

74   *Id.*

75   *Id.*

76   *Id.*

77   *Id.*

78   *Id.*

Social/Equity

- Studies in Louisville and in other cities across the country have shown that wealthier communities have up to twice as many trees as lower-income areas.[79]

- In Baltimore, tree canopies cover 2/3 of high-income neighborhoods, while lower-income areas, like Broadway East, are covered by only 10% tree canopy.[80]

- Statistically speaking, communities with lower tree canopy coverage tend to be those with the highest rates of unemployment.[81]

- Studies have shown that nature can help improve one's health and mood; having just ten more trees on one's block can help improve "health perception in ways comparable to an increase in annual personal income of $10,000 and moving to a neighborhood with $10,000 higher median income or being 7 years younger."[82]

- Tree planting can provide career opportunities to members of the applicable community—including their maintenance and mapping of tree canopy coverage in certain areas.[83]

Administrative

- The most effective tree planting policies are programs that encourage planting trees on private land.[84]

- Planting trees does not have an immediate cooling effect. After planting, a tree does not grow enough to provide canopy to cool an area for 20 to 30 years,[85] so tree planting should be combined with other policies that can help reduce temperatures in the immediate term.

- Several cities have already implemented tree planting programs. Washington, DC has plans to cover 40% of the city with tree canopy by 2032. Seattle has a similar plan—30% coverage by 2037.[86]

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79 Anderson, *supra* note 62.

80 Valerie Yurk, *US Cities are Spending Millions on Trees to Fight Heat—But Are Their Plans Equitable?*, The Guardian (Aug. 26, 2020), **https://www.theguardian.com/environment/2020/aug/26/us-cities-trees-heat-equitable**.

81 *Tree Equity in America's Cities*, *supra* note 72.

82 Jessica Stillman, *Science: This Tweak to Your Environment Makes You Feel $10,000 Richer and 7 Years Younger,* Inc. (Oct. 30, 2017), **https://www.inc.com/jessica-stillman/more-trees-on-your-street-makes-you-feel-happier-healthier-science-shows.html**.

83 *Tree Equity in America's Cities*, *supra* note 72.

84 *Id.*

85 *Id.*

86 Yurk, *supra* note 80.

Participant Commentary

Consistent concerns listed by several stakeholders:

- There are concerns about the role of gentrification and development of open areas in reducing tree canopy cover in their neighborhoods over time;

- Even when trees are replaced or new trees are planted, those that are planted are smaller and will not mature for years to come, or may not provide enough shade coverage, no matter how long they are given to mature;

- The trees that are planted often are not maintained by city staff;

- Much of the public land within their neighborhoods is owned by the federal government, so members of the community do not have the ability to determine what is done to the land in their communities; and

- Older residents were concerned about safety around parks that have significant tree coverage, in that trees could provide cover for individuals looking to perpetuate robberies.

Other commentary:

- Elderly stakeholders recalled having more trees in their neighborhoods when they were children, whereas today, there are significantly less shade trees. They reported that the areas they used to go to, including parks and creeks, have been demolished and/or redeveloped.

- In every meeting, stakeholders listed planting and maintaining trees as a top priority to combat urban heat islands and higher temperatures.

Potential policy or legislative solutions included:

- Developing a plan—either by the Federal Government or the DC government specifically—to expand tree programs, including keeping existing trees within their communities;

- The creation of a fund to ensure that trees planted by the City are properly cared for;

- Planting shade trees near where people wait for public transit in order to help people stay cool; and

- Ensuring that tree planting programs are implemented alongside other policy options.

Case Studies and Resources

The Cleveland Tree Plan

In 2015, Cleveland, Ohio completed an assessment of the city's urban forest and developed a strategy for enhancing and restoring it. The Cleveland Tree Plan emphasizes the importance of a healthy urban forest in an overall strategy for preparing for climate change, as trees can help manage stormwater and reduce urban heat, in addition to providing other benefits ranging from carbon sequestration to reduced energy costs and improved property values. The plan integrates equity considerations through a "Plant with a Purpose" strategy aimed at narrowing the neighborhood gaps in tree canopy, by prioritizing tree planting sites based on overall canopy, socioeconomic characteristics, stormwater management, energy savings, heat stress reduction, public health, economic development and neighborhood revitalization, and vacant land use. The plan includes a map indexing tree canopy need by neighborhood according to equity-based socioeconomic factors. A full "Plant with a Purpose" implementation strategy by neighborhood is included in Appendix B of the plan. As part of the planning process, the planning team also identified a need for the city to update its tree ordinance to better integrate environmental justice.

South Ironbound Resiliency Action Plan - Newark, New Jersey

The South Ironbound Resiliency Action Plan lays out resiliency goals for a portion of the Ironbound neighborhood in the East Ward of Newark, New Jersey called South Ironbound, that will inform funding priorities and inform longer-term climate mitigation and adaptation goals. The plan was developed by the Ironbound Community Corporation's Community Development & Environmental Justice Program in partnership with the American Planning Association New Jersey Chapter's Community Planning Assistance Program, and with input from community members. The neighborhood is prone to flooding due to sewer back-ups, heavy rain storms, and storm surge; it has historically had industrial operations mixed with residential and commercial uses, and is surrounded by rail, airport, and port infrastructure on three sides. Accordingly, residents identified air quality, contamination and vacant lots, lack of recreational space, and other public health and safety issues as priority concerns. In order to address many of these concerns, the plan includes green infrastructure and brownfield redevelopment/adaptive reuse as key components to build resilience. A proposed "Greening Vacant Lots" program would transform city-owned vacant lots into urban stormwater parks or other pocket parks/greenspace. The plan emphasizes projects and action items such as green infrastructure demonstration projects that will foster social cohesion while addressing key goals like crime prevention and flood mitigation.

Portland, Oregon Tree Code

The City of Portland, Oregon has a tree ordinance that, under the guidance of the city's Urban Forest Master Plan, establishes a framework and requirements relating to the preservation and maintenance of the city's urban forest. Among the stated purposes of the tree code are "capturing air pollutants and carbon dioxide," "[f]iltering stormwater and reducing stormwater runoff," "[r]educing energy demand and urban heat island…" sustaining habitat, and more. The tree code sets out requirements that must be met regarding tree removal and replacement in both development and non-development circumstances, and in the context of city and street trees as well as private trees. A dedicated Tree Planting and Preservation Fund is established to "advance the City's goals for the urban forest and intend to achieve equitable distribution of tree-related benefits across the City," among other purposes. Equitable distribution of investments in the city's urban forest is consistent with the city's 2007 Urban Forest Action Plan, which includes targeting low-income and low-tree-canopy neighborhoods for street tree planting as high priority early actions.

Jade District Greening Initiatives - Portland, Oregon

This initiative involves targeted tree canopy investments in the Jade District in Portland, Oregon—a neighborhood with significant health and economic disparities. To address these disparities, a portion of the Jade District had been designated as a Neighborhood Prosperity Initiative area by the city development commission. With assistance from Oregon-based organizations including the Asian Pacific American Network of Oregon (APANO) and the MultiCultural Collaborative, the community residents and businesses engaged in a visioning process and set priorities for neighborhood development initiatives. The community identified green infrastructure and tree planting priorities, which were then further developed through two separately-funded and supported efforts: the EPA's Greening America's Communities program, and the state's Oregon Solutions program. The EPA funded effort ("Greening the Jade") focused on three green infrastructure demonstration projects and developed design options that could be applied in other areas throughout the district. The parallel Oregon Solutions Project involved a formalized process of stakeholder and community engagement to develop community-centered strategies for greening the neighborhood and the development of an implementation plan detailing commitments of various agencies and organizations to support the health, safety, and environmental vision for the community.

Million Trees Miami - Miami-Dade County, Florida

Through its Million Trees Miami initiative, Miami-Dade County is prioritizing tree planting in low-income communities with low tree canopy that face the greatest threats from heat stress as a result of increasing temperatures from climate change. The County's 2006 Street Tree Master Plan set a goal to achieve 30% tree canopy in the county by 2020. Neat Streets Miami, a multi-jurisdictional county board, is working to implement this goal through the Million Trees Miami initiative. This initiative aims to plant 1 million trees in order to achieve the goal of 30% canopy cover to reduce urban heat islands in the County. Through a 2016 Urban Tree Canopy Assessment, the County found that higher-income areas had greater tree canopy and lower-income areas, including predominantly black and Latinx neighborhoods, had less tree canopy. As a result, the County is prioritizing tree planting in its most impoverished and low-canopy areas through initiatives like the Street Tree Matching Grant.

Cool Pavements and Roofs

Installed in 2001 as part of an Environmental Protection Agency study, Chicago City Hall is an example of an urban green roof that was built specifically to help combat the urban heat island effect. Credit: Joe Wolf

Cool pavements and roofs are made of materials that reflect sunlight or enhance water evaporation more than traditional paving and roofing materials.[87] Through higher solar reflectance and lower heat absorption rates, cool roofs and pavements can lessen urban heat island effects.[88] Cool pavements can be created using existing paving technologies that have a higher albedo (reflectance), or through techniques that increase permeability, such as grass coating or newer paving materials that allow for greater infiltration of stormwater and subsequent evaporative cooling.[89] In other words, the two basic categories of cool pavements use porous, permeable materials, or repaint/repave with lighter colored materials.[90]

Cool roofing materials are made of highly reflective paints or other materials. With a higher solar reflectance than conventional roofs, cool roofs can be 50-60 degrees Fahrenheit cooler than conventional roofs during peak summer

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87   For a more in-depth description of cool pavements and roofs, *see* Sara Hoverter, *Adapting to Urban Heat: A Tool Kit for Local Governments*, Geo. Climate Ctr. (Aug. 2012), **https://www.georgetownclimate.org/files/report/Urban%20 Heat%20Toolkit_9.6.pdf**.

88   *Id.*

89   *Using Cool Pavements to Reduce Heat Islands*, EPA (2021), **https://www.epa.gov/heatislands/using-cool-pavements-reduce-heat-islands**.

90   Hoverter, *supra* note 87.

weather.[91] This decreased temperature results in reduced energy use and cost, which in turn reduces emissions. Although cool roofs do reflect some valuable heat energy in the winter, overall, they reduce energy costs and are longer-lasting than traditional roofs. There are a variety of ways to install a cool roof, including using a sealant or coating that is more reflective than traditional roofing; using reflective roofing tiles; cool-colored metal roofing; and asphalt shingles.[92]

Another option to cool roofs are green roofs. Green roofs use vegetation and natural infrastructure to cool a roof, and are typically composed of several layers—"a waterproof membrane to protect the underlying roof, a drainage layer, a growing medium such as soil, and the plants themselves."[93] After installation, the temperature difference between a green roof and a traditional black roof can be upwards of 100°F.[94] This vegetation can help reduce GHG emissions through carbon capture, and help to reduce stormwater runoff.

Cities can increase the use of cool roofs and pavements through government actions, such as public works and streets programs installing cool pavements in place of traditional pavements; incentive programs, such as rebates that help residents reduce the cost of installing cool or green (vegetated) roofs; and mandates, such as cool roof ordinances and stormwater management requirements that ensure new development is built with features that will help reduce urban heat.

Analysis

DC Programs

DC administers development requirements and grant programs that can help transform the city's traditional pavements and roofs into cooler alternatives. Various agencies have partnered together to implement cool roof and pavement programs throughout the city. For example, the District of Columbia Housing Authority (DCHA) has worked since 2004 to improve the energy efficiency of their 8,000 residential units, which includes retrofitting roofs with green infrastructure (green roofing), renewable energy, and efficient water heaters and cisterns.[95] The Department of General Services (DGS) runs the SmartRoof Program, which is working to install both cool and green roofs on structures within its municipal portfolio, including schools, fire stations, parks and recreation centers, and city-owned office buildings.[96] The District has also implemented a construction code for commercial buildings and parking garages that require certain structures to install roofing that has a specific level of solar reflective index—essentially mandating that cool roofing technology is used.[97]

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91 *Id.*

92 *Id.*

93 *Id.*

94 *Id.*

95 This plan is currently being updated by the appropriate agencies. *Climate of Opportunity: A Climate Action Plan for the District of Columbia*, Green DC (Sept. 2010), **https://doee.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/ClimateOfOpportunity_web.pdf**.

96 *Washington D.C. Smart Roof—Roof Asset and Energy Management Program*, Adaptation Clearinghouse (Oct. 2013), **https://www.adaptationclearinghouse.org/resources/washington-d-c-smart-roof-roof-asset-and-energy-management-program.html**.

97 Structures covered by this mandate are those with "roof slopes less than or equal to two units vertical in 12 units horizontal (17-percent slope or less) for buildings and covered parking... A minimum of 75% of the entire roof

DOEE's RiverSmart Program promulgates several projects that install cool and green roofs, as well as cool pavement.[98] The Program works through funding projects—by using grants and rebates—that reduce stormwater runoff and water pollution issues. The three programs funded through grants are:

- **RiverSmart Homes**: This program provides financial assistance to homeowners looking to install stormwater reduction features, which can include green roofing projects.

- **RiverSmart Communities**: This Initiative provides financial assistance to nonprofits and places of worship to install stormwater reduction features, which can include green roofing projects.

- **Community Stormwater Solutions**: Under this program, community projects that "reduce stormwater pollution, reduce trash, promote environmental education, and build climate resilience in priority sub-watersheds" are able to receive funding.[99]

The three programs that offer rebates to property owners are:

- **Rain Garden Rebate Program**: Property owners that install rain gardens on their property—which can include on the roof—can receive rebates up to $2,200.

- **Permeable Surface Rebate Program**: Homeowners who repave impervious surfaces—such as driveways or patios—with permeable pavement can receive rebates up to $5 per square foot.

- **Green Roof Rebate Program**: Property owners that install green roofs can receive rebates up to $15 per square foot for up to $20,000.

Considerations and Tradeoffs

Economic

- The cost of cool pavement material can vary widely depending on the contractor, time of year, and materials.

- The cost of a cool roof or pavement can be prohibitive, and programs incentivizing their installation are sometimes limited. For example, only eligible businesses can apply for DC's Great Streets grant program, and many low-income residents may not have the funds to change their homes' roof into a cool roof.

- Cool pavements sealant is relatively cheap—one type, CoolSeal, costs around 30 to 40 cents a square foot, and even less in larger quantities.[100]

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surface not used for roof penetrations, renewable energy power systems (e.g. photovoltaics or solar thermal collectors), harvesting systems for rainwater to be used on-site, or green roofing systems" shall be covered by products that have a minimum solar reflective index of at least 78, or that comply with the EPA's Energy Star Programs. D.C. Mun. Regs. tit. 15A, § 1511 (2008); *Cool Roofs and Cool Pavements Toolkit*, Global Cool Cities All. (2020), **https://www.coolrooftoolkit.org/knowledgebase/washington-dc-construction-code-residential-cool-roof-provisions/#:~:text=Washington%2C%20DC's%20Construction%20Code%20of,conform%20to%20the%20this%20section.**

98 *District of Columbia's RiverSmart Program*, Adaptation Clearinghouse (2006), **https://www.adaptationclearinghouse.org/resources/district-of-columbia-s-riversmart-program.html.**

99 *Id.*

100 Sam Bloch, *The Problem with 'Cool Pavements': They Make People Hot*, Bloomberg CityLab (Oct. 3, 2019), **https://**

- "According to the **Environmental Protection Agency**, the price of a cool roof coating can range from $0.75 to $3.00 per square foot. For a home with a typical 1,500 square foot roof, installation costs can add up to between $1,600 and upwards of $6,500."[101]

- Using permeable materials for cool pavement purposes can help save developers money, as they can take the place of some types of stormwater infrastructure, including pipes, gutters, and/or drains.[102]

- The installation and operation of green roofs can be extremely expensive. Costs of installation range between $10 to $25 per square foot. Additionally, annual maintenance can cost up to $1.50 per square foot, to keep the green roof functional.[103]

- Cool roofs and pavements "do not provide a net economic or environmental benefit in areas with extremely cold winters and relatively mild summers. These areas would experience higher heating costs in winter, because of the heat-reflecting effect of cool roofs. The added winter costs would be greater than any savings from reduced cooling costs in summer."[104]

Environmental

- There are several different types of cool pavement options, including lightly colored asphalt, concrete, and permeable pavements.[105] On top of alleviating heat stress, permeable pavements provide the added benefit of reducing runoff and improving water quality by filtering stormwater through its surface.[106]

- By lowering the temperature of a home, and thus decreasing the amount of energy necessary to cool the home, cool roofs can help reduce air pollution and the GHG emissions associated with running air conditioning units.[107]

- Reflective roads can actually make people feel hotter, due to the reflective nature of the coating on the roads.[108] Similarly, the reflective nature of cool roofs can "bounce the light [from itself] onto taller neighboring buildings, warming up those buildings instead."[109]

- Green roofs can help reduce the amount of emissions in several ways. For example, the vegetation installed can help capture carbon and GHG emissions; the cooling effect green roofs have on a building may result in less air conditioning, thus decreasing the need for their operation; and green roofs can reduce and filter stormwater.[110]

- While cool pavements have health and emissions benefits, there are also environmental costs associated with installation. In some instances, costs can "exceed the expected energy and emissions savings from reduced space conditioning (cooling and heating) in buildings."[111]

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www.bloomberg.com/news/articles/2019-10-03/reflective-pavement-may-be-less-cool-than-it-seems.

101 *Should You Replace Your Roof with a Cool Roof*, Renew Fin. **https://renewfinancial.com/resources/should-you-replace-your-roof-cool-roof#:~:text=According%20to%20the%20Environmental%20Protection,%241%2C600%20and%20upwards%20of%20%246%2C500** (last visited Jan. 15, 2021).

102 Hoverter, *supra* note 87.

103 *Id.*

104 *Id.*

105 *Cool Pavement: General*, Pavement Interactive, **https://pavementinteractive.org/reference-desk/pavement-management/impacts/cool-pavementgeneral/** (last visited Jan. 15, 2021).

106 Hoverter, *supra* note 87.

107 *Id.*

108 *Id.*

109 *Id.*

110 *Id.*

111 Julie Chao, *Not All Cool Pavements are Created Equal*, Berkeley Lab (May 18, 2017), **https://newscenter.lbl.gov/2017/05/18/not-all-cool-pavements-are-created-equal/**.

Social/Equity

- Some cities offer cool roof rebates to homeowners, and "many jurisdictions now have policies that require information to be translated into their communities' most widely spoken languages; and distributed through channels where they are more likely to reach intended audiences, such as supermarkets, transit hubs, and places of worship."[112]

- Green roofs are expensive and can be cost prohibitive to homeowners.[113] While rebate programs can help residents, businesses, and landlords with the costs of installing cool and green/vegetated roofs and other features, expenses are typically reimbursed after installation, and upfront costs required to install these features may be prohibitive without the financial assistance in hand.

- Green roofs require structurally sound buildings to support their weight. Lower-income communities typically are more likely to have older housing and structures, which may not have the necessary stability to support a green roof.[114]

- Lower income households and people of color are less likely to own homes and more likely to rent.[115] Residents living in apartment buildings may not have the power to collectively decide whether to install a cool roof, and landlords or building owners may not be willing to invest in cool roofs.

Administrative

- Cool pavements have faced implementation barriers, including concerns related to wear and tear and longevity (especially with permeable pavements), and the reflective glare that they can cause for drivers (with reflective pavements).[116] Additionally, they do not directly cool buildings; instead, they indirectly decrease temperatures within the surrounding area.[117]

- Because of the reflective nature of cool roofs, studies have shown that in urban areas, they should be installed more sparingly on shorter buildings. Areas where the height of buildings are similar have the most beneficial effects.[118]

- Green roofs require significant upkeep, including irrigation and fertilization to keep the plants alive.[119]

- Cities have implemented cool roof programs that fully subsidize their installation on buildings serving a public interest, such as schools, shelters, and community centers.[120]

- "Local governments have a wide variety of policy tools available to promote cool roofs, including building codes, grant programs, utility rebates, and others."[121]

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112 *Heat Islands and Equity*, EPA (2016), **https://www.epa.gov/heatislands/heat-islands-and-equity**.

113 Hoverter, *supra* note 87.

114 *Id*.

115 *Racial Disparities Among Extremely Low-Income Renters*, Nat'l Low Income Housing Coal. (Apr. 15, 2019), **https://nlihc.org/resource/racial-disparities-among-extremely-low-income-renters**.

116 Bloch, *supra* note 25.

117 Hoverter, *supra* note 87.

118 *Id*.

119 *Id*.

120 *Heat Islands and Equity*, *supra* note 1128.2021.

121 Hoverter, *supra* note 87.

Participant Commentary

Consistent concerns listed by several stakeholders:

- Longtime residents noted that streets were much cooler in the past, before significant development in their communities.
- There is a lack of awareness regarding the program generally, and not enough information on costs associated with retrofitting options like cool roofs or pavements.

Other Commentary:

- When the idea of cool streets and roofs was raised, the community members were generally receptive to these approaches.
- A few residents in the second community meeting cited cool roofs and streets as their preferred strategy for implementation by DC.

Potential policy or legislative solutions included:

- Better education and outreach alerting communities and individuals to the existence of these programs (see Communication and Outreach section).

Case Studies and Resources

Adapting to Urban Heat: A Toolkit for Local Governments

This tool kit, developed by the Georgetown Climate Center is designed to help local governments reduce the effects of increased heat on their communities and citizens. It provides an analytic tool for policy makers to consider a combination of four built-environment changes, providing clear criteria for selecting among these approaches. It also examines the roles government can play in pursuing these changes: shaping government's own operations, mandating or providing incentives for private choices, and engaging in public education. The menu of options it provides does not prescribe a particular path for all communities. Instead, it offers a complete list of options and the means to select among them to fit particular circumstances. Among the options included within the toolkit are the implementation of both cool roofs and cool pavements. The toolkit outlines the benefits and drawbacks of installing these types of adaptive measures, and discusses different policy options available to local governments that can help encourage their implementation.

Cool Policies for Cool Cities: Best Practices for Mitigating Urban Heat Islands in North American Cities

This survey by the American Council for an Energy Efficient Economy (ACEEE) and the Global Cool Cities Alliance (GCCA) reviews the urban heat mitigation activities of 26 cities in the U.S. and Canada — representing all of the major climate zones, geographies, and city sizes across North America. It describes a case study of Houston, TX, which was one of the first cities to adopt a cool-roof ordinance. In 2007, Houston Mayor Bill White commissioned an independent impact study for cool roofs from the Houston Advanced Research Center (HARC). This study found that cool roofs would result in potential environmental and economic benefits, and this inspired the adoption of a cool-roof requirement in the Houston Commercial Energy Conservation Code of 2008. The Energy Conservation Code, enforced by the Code Enforcement Division of the Department of Public Works and Engineering, requires that air-conditioned government, commercial, and multifamily residential buildings that install or replace low-slope roofs have a minimum initial solar reflectance of 0.70 and a minimum thermal emittance of 0.75. The city's adoption of the conservation code and the tree ordinance, paired with multi-department and citizen involvement, has made an immediate and lasting positive impact in cooling Houston.

Louisville, Kentucky Cool Roof Rebates

In 2016 the Louisville Office of Sustainability commissioned a study from Georgia Tech's Urban Climate Lab to map the hottest areas of the city. The study revealed that not only was Louisville's urban heat island one of the most severe in the nation, but the hottest areas of the city were, not surprisingly, also where the most vulnerable frontline communities were located. The study recommended a variety of interventions, including policies promoting cool surfaces, increased vegetation, and energy efficiency strategies, with combinations of measures having greater benefits than each individual intervention when deployed in the same area. One of the interventions that Louisville implemented was a rebate for cool roofs that property owners installed on their buildings. In order to ensure that some of the voluntary funding was allocated for low-income, more vulnerable areas, the office designated 70% of the funding to go to neighborhoods identified in the study as having the most severe heat islands. While rebates can be difficult for low-income property owners, the techniques used to target the program to areas of the highest need can be replicated in other places for grants or no-interest loans. The program was funded through a partnership with Louisville's energy utility.

Cool Roofs and Cool Pavements Toolkit

From the Global Cool Cities Alliance, this toolkit provides online access to a comprehensive set of resources for initiating cool roof and pavement programs. Available within the toolkit, and a good starting point on the site for general information, is the 'Knowledge Base' portal, a repository for cool surface and urban heat island information. The Knowledge Base is a user-friendly tool to find research, program materials, sample documents, presentations, case studies, codes and standards, videos, images and other relevant items from around the world.

Splash Parks and Water Access

Spray caps, pictured here, moderate the amount of water released by fire hydrants to allow for safe, more environmentally friendly public water access in urban areas. Credit: NYC DEP

On a hot day, there's no relief like a splash of cool water, which if made accessible and resource-efficient, can help curb the effects of extreme heat for many communities. The ability to conserve and reuse water is another benefit of splash pads and parks, as a well-designed splash pad or park can either have its water treated and recirculated using a filtration system or diverted for other uses. It can also demonstrate these concepts to its users as part of a larger sustainability agenda.

Analysis

DC Programs

DC's Department of Parks and Recreation operates several spray and splash parks throughout the district. These small outdoor parks are "equipped with kid friendly fountains that are perfect for splashing around and escaping the summer heat. There is at least one spray park in every ward of the District."[122] It operates an interactive map on its **website**.

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122   *Spray Parks*, Dep't of Parks and Recreation, **https://dpr.dc.gov/page/spray-parks** (last visited Jan. 19, 2021).

Considerations and Tradeoffs

Economic

- The installation and maintenance of splash pads and parks can be incredibly expensive for a city. Case studies of Georgia and Florida splash parks report the cost of installation ranging between $145,000 and $2.3 million, which often includes the construction of picnic tables, public restrooms, changing rooms, and concession stands.[123]

- Other costs include hiring lifeguards, water quality experts, and recreational officers.[124]

- To recoup costs, some communities charge moderate fees for each visitation. For example, in Georgia, admission to a splash pad in Americus costs $3 for children 12 and under, and for the rest of the population, a $3 charge with a $5 membership fee.[125]

- Other parks charge fees for renting out the public space for parties and rentals.

Environmental

- Certain areas or neighborhoods may not have access to water sources such as rivers, lakes, etc. to open for public access. Splash pads and spray parks make a good alternative.

- In comparison to community pools, splash pads are significantly more sustainable in terms of water usage and conservation.

- Whereas community pools contain between 70,000 and 120,000 gallons of water that needs to be recirculated every four to six hours, splash pads can be motion activated, ensuring that when no one is using the splash pad, water is not wasted through continuous use.[126] This is especially important for areas that experience drought.

- Water used in splash pads can also be more easily recycled and used for other purposes like watering nearby infrastructure, as splash pad water typically is not treated with the same chemicals with which pool water is treated.[127]

123 Taha Hameduddin & Megan LePere-Schloop, *Best Practices for Public Splash Pads: Case Studies from Georgia and Florida*, UGA Archway P'ship (Sept. 5, 2013), **http://www.mvrma.com/pdfs/11%20Best-Practices-for-Public-Spash-Pads_Taha-Hameddudin_FINAL.pdf**.

124 *Id.*

125 *Id.*

126 Josh Martin, *First-Class and Financially Feasible*, PRB (2016), **https://www.parksandrecbusiness.com/articles/2016/6/first-class-and-financially-feasible**; Raine Gardner, *The Splash Pad Revolution—Cool Locales, Hot Commodities*, MSA (July 27, 2018), **https://www.msa-ps.com/the-splash-pad-revolution-cool-locales-hot-commodities/#:~:text=Sustainable.,as%20watering%20plants%20and%20trees**.

127 *Id.*

Social/Equity

- Should splash parks charge for admission, implementers of spray and splash parks should keep in mind that some families may not be able to afford the membership fees associated with using splash or spray parks.
- Splash pads and parks need to be located in areas that are easily accessible by frontline community members.
- These water features should also be accessible to individuals with disabilities.

Administrative

- Splash pads and public places where they can be installed may be closed—or have limited access—due to COVID.
- Successful implementation of splash pads often involved their installation near other public amenities, such as pools, picnic areas, or community centers.
- Unlike pools, the nature of splash pads (flat splash deck and the ability to turn the water on and off) enables the areas surrounding them to be used for secondary functions.
- "The dual-purpose design intent allows the public to enjoy the fountains as a splash pad during the day, while also being available for reserved (and possibly even paid) private functions in the evening."[128]

Participant Commentary

Other commentary:

- Splash pads weren't brought up much in participant commentary, but when they were, people agreed that their installation is important, especially for children.
- Stakeholders did, however, bring up opening fire hydrants as a way to cool down in neighborhoods, which is not permitted from a fire safety perspective. Splash pads could replace this concept, but they would need to be installed more broadly in frontline communities.
- Other options for water-related cool down measures include bringing a fire truck to the community and using water cannons.

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128 Martin, *supra* note 126.

Case Studies and Resources

NYC H.E.A.T Program: Fire hydrant abuse prevention

The New York City Department of Environmental Protection's (DEP) 2019 Hydrant Education Action Team (HEAT) program is a fire hydrant abuse prevention campaign that deploys teams of teens hired through the Department of Youth and Community Development's Summer Youth Employment Program to inform New Yorkers about the dangers of illegally opening fire hydrants. The program educates residents on how the hydrants can be opened legally if equipped with a City-approved spray cap. The spray cap releases only 20 to 25 gallons per minute, ensuring adequate water pressure and reducing the risk that a child could be knocked over and injured by the force of the water. Spray caps can be requested by an adult 18 or over, free of charge, at local firehouses.

NYC Municipal Water Efficiency Program: Timed Spray Showers

The New York City Departments of Environmental Protection (DEP) and Parks and Recreation installed water-saving automatic shut-off timers and activation buttons on 400 spray showers at City playgrounds in order to conserve water by ensuring that showers are activated only when in use. The $3 million initiative, funded by DEP and jointly managed through a partnership with NYC Parks, is part of a larger citywide effort to reduce water consumption by 5 percent. The timed spray showers were developed through the Municipal Water Efficiency Program, an interagency partnership that implements water conservation strategies at City-owned properties and facilities. The project also included water-saving retrofits to bathrooms in nine NYC Parks Recreation Centers. Timed playground spray showers are the result of significant interagency cooperation to conserve water during high demand summer months by ensuring that the showers are activated only while in use. Now that these 400 spray showers have been upgraded, it is projected that citywide water consumption will be reduced by 1.1 million gallons per day. All newly constructed spray showers in playgrounds also utilize water-saving timers.

Temporary Housing Programs

Temporary housing programs often place unhoused individuals or families in hotels or motels during extreme weather conditions. Credit: Wikimedia Commons

Using hotels or motels for people experiencing homelessness during inclement weather typically involves sending individuals from homeless "camps" to motels or hotels nearby. "Inclement weather" can be different for each city/region, and can include heavy precipitation (rain or snow), heat, or cold weather.

In many instances, these programs operate using some sort of voucher program. During inclement weather events, hotel or motel vouchers are distributed to homeless populations in instances when no other housing solution—such as a shelter—is available. The voucher often extends beyond a one day stay to upwards of 28 nights. Additionally, individuals using a voucher can be required to partake in a planning program that can include training on housing options, employment opportunities, finances, and more. To remain housed in a hotel or motel, those participating in the program must adhere to the hotel or motel's guidelines, which typically prohibit activities associated with criminal behavior, damaging property, and disturbing the peace.

It is important to note that many cities are using hotels and motels to house populations experiencing homelessness during the COVID crisis to slow the virus's spread. In DC, as of April 22, almost 250 individuals experiencing homelessness were quarantining/placed in hotels throughout the City.[129] Other cities or regions implementing similar programs include, but are not limited to, New York City, Chicago, King County in Washington State, and several cities across Massachusetts.[130]

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129 Andrew Giambrone, *More Than 200 Residents Experiencing Homelessness Are In Quarantine at Five D.C. Hotels*, The DCist (Apr. 23, 2020), **https://dcist.com/story/20/04/23/more-than-200-residents-experiencing-homelessness-are-in-quarantine-at-five-d-c-hotels/**.

130 *See*, for example, Sally Lockwood, *Empty Hotels Being Used as Homeless Shelters Shows the Huge Economic Cost of COVID in New York*, Sky News (Oct. 18, 2020), **https://news.sky.com/story/empty-hotels-being-used-as-homeless-shelters-shows-the-huge-economic-cost-of-covid-in-new-york-12105664**; Joe Barrett, *To Fight Coronavirus, Chicago Moved Homeless Residents Into a Hotel. Now What?*, Wall S. J. (July 24, 2020), **https://www.wsj.com/articles/to-fight-coronavirus-chicago-moved-homeless-residents-into-a-hotel-now-what-11595617499**;

Analysis

DC Programs

In general, DC's Department of Human Services handles homeless services within the District. DHS (or an interagency collaboration that includes officials from this agency) manages any policies or programs developed to address homelessness in DC, including housing homeless individuals or families during extreme weather events.

In 2015, DC's Interagency Council on Homelessness released its Strategic Plan for 2015 to 2020, *Homeward DC*. *Homeward DC* outlines several strategies that the District and its agencies would adopt to help end homelessness across the City.[131] Among these strategies included the placement of underhoused families into motels or hotels if shelters overflowed. However, in August 2020, Mayor Muriel Bowser announced that the District would stop using hotels or motels as overflow emergency shelters for underhoused families, due in part to the six new family shelters built throughout the City.[132]

Considerations and Tradeoffs

Economic

- Hotel vouchers for people experiencing homelessness can be prohibitively expensive for cities to implement.
- In San Diego County, the Housing and Community Development Agency, in partnership with the Health and Human Services Agency, requested more than $100,000 to fund the program for a year.[133]
- In New York, the Department of Homeless Services estimated that the average hotel room costs around $225 a night.[134]

Brooke Wolford, *Moving Homeless into Hotels Helped Limit COVID-19 Spread, Washington Study Finds,* The News Trib. (Oct. 7, 2020), https://www.thenewstribune.com/news/state/article246295670.html; Joe Dwinell, *Coronavirus in Massachusetts: Millions Spent on Hotels to House Homeless, Others Infected During Pandemic*, Boston Herald (Aug. 16, 2020), **https://www.bostonherald.com/2020/08/16/millions-spent-on-hotels-to-house-homeless-others-infected-during-pandemic/**.

131 Homeward 2015-2020, District of Columbia Interagency on Homelessness (2015), **https://ich.dc.gov/sites/default/files/dc/sites/ich/page_content/attachments/ICH-StratPlan2.11%20web.pdf**.

132 Press Release, *Mayor Bowser Announces Major Milestone in District's Plan to End Homelessness*, Govt. of the District of Columbia (Aug. 13, 2020), **https://mayor.dc.gov/release/mayor-bowser-announces-major-milestone-district-plan-end-homelessness**.

133 *County of San Diego Consortium: 2019-19 Consolidated Plan and 2015-16 Annual Funding Plan*, County of San Diego Dep't of Hous. & Comty. Dev. (May 2015), **https://www.sandiegocounty.gov/content/dam/sdc/sdhcd/docs/2015_19_Con_Plan_Annual_Plan.pdf**.

134 Mark Chiusano, *Homeless in a Chelsea Hotel: No Key and No Kitchen*, AMNY (Jan. 9, 2018), **https://www.amny.com/opinion/homeless-in-a-chelsea-hotel-no-key-and-no-kitchen-1-16040221/**.

Environmental

- N/A

Social/Equity

- Many programs only offer hotel or motel vouchers to families, rather than individuals. Because of this, underhoused populations can be left out in the cold—literally and figuratively.

Administrative

- Some programs require that participants also take part in training programs that can assist families experiencing homelessness, such as financial literacy classes, workforce development or training programs, etc.
- Issues associated with these types of programs include lack of a kitchen area or place to cook in the hotel/motel room, rules against congregating in common spaces (especially during COVID), and the use of hotels/motels for criminal behavior.
- Programs that place underhoused populations in hotels can be used in other instances outside periods of inclement weather—such as during the COVID pandemic. Hotels, rather than shelters, can be used in this instance to prevent the spread of the disease, as individuals and families are given their own, individual rooms, rather than live in a communal setting.

Participant Commentary

Consistent concerns listed by several stakeholders:

- The District currently is not doing enough to take care of its underhoused population, especially during inclement weather.

Potential policy or legislative solutions included:

- Placing individuals experiencing homelessness in hotels during certain times of the day to avoid staying outside during dangerous weather conditions; and
- Creating a stronger network among service providers to better connect people experiencing homelessness to services in the area.

Case Studies and Resources

Denver, Colorado

The Denver Department of Human Services (DHS) offers a Cold Weather Motel Voucher program, which is designed to ensure that underhoused families have a temporary place to stay during colder, inclement weather. Vouchers are offered by DHS between October and April, during periods when the temperature drops below 40 degrees and when all Denver shelters are at capacity. Families with children under the age of 18 can apply for a voucher through the program, and stay in a participating motel for up to two weeks. In addition to receiving temporary housing, families will also be enrolled in a case outcome planning program, which will coach families through housing options, employment training, and additional benefits.

San Diego County, California

Since 1997, San Diego County, California's Department of Housing and Community Development, in collaboration with the Health and Human Services Agency, implemented the Cold Weather Shelter Voucher Program, which provides emergency hotel and motel vouchers to underhoused families and individuals—older adults, people with disabilities, and pregnant women—during winter months or inclement weather. Participants are permitted to stay for up to 28 days in the hotel/motel, and during this stay, will have access to resources that will help the individual or families find more permanent housing.

The District of Columbia

Under the auspices of DC law, the Interagency Council on Homelessness is required to meet the emergency housing needs of both underhoused families and individuals experiencing homelessness in instances of severe weather—whether hot or cold. As a result, the District's Department of Human Services (DHS) works with hotels and motels in the greater metropolitan area to provide rooms for families and individuals when there are no vacancies at shelters. Due in part, however, to DC's Homeward initiative and other homeless services, the number of participants in the program has dwindled as people have either been transferred to permanent housing or other shelters. The District's Winter Plan 2021 notes that the Department has retained 250 hotel rooms in the Days Inn during winter months.

Mapping Heat Islands
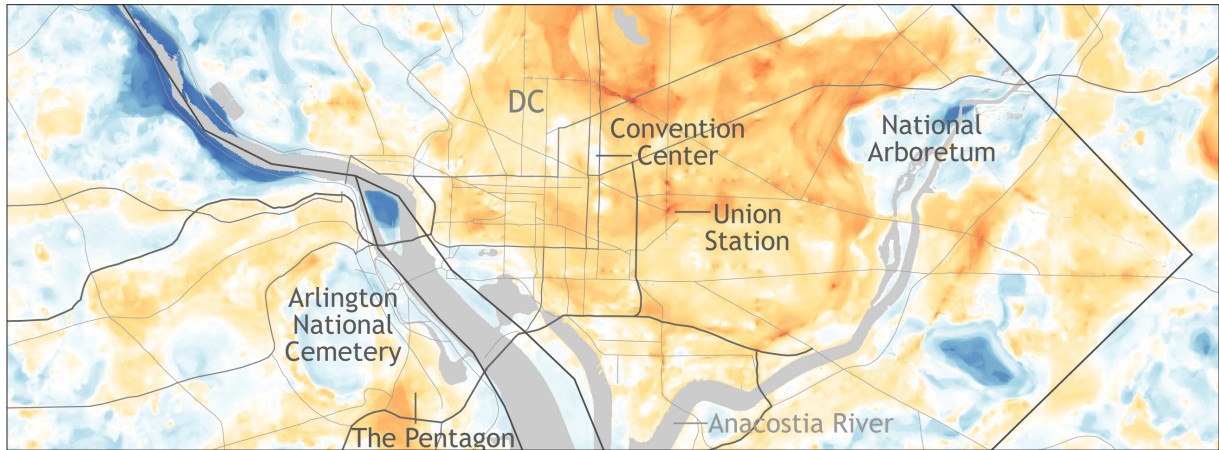
2019 District of Columbia urban heat island map created by NOAA and the Portland State University in Oregon based on afternoon (3pm) temperatures. Credit: NOAA

There are two options for mapping urban heat that city officials may find useful: static and real-time. Real-time urban heat maps can offer an easy-to-use application that will show users in real time which areas of their city are the hottest, and where people can go to escape the heat. Real-time temperature tracking requires temperature sensors throughout the city that continually take the temperature in the surrounding area. Ideally, these heat maps can be used by both citizens and policymakers. The former can use this tool to assess health risks associated with certain temperatures, to provide notifications when temperatures reach user-specific dangerous levels, and recommend nearby cooling centers for relief. For policymakers, seeing in real time where a city is hottest can help to determine where the construction or development of a cooling center may be most useful.

Static heat maps, on the other hand, use specific temperature inputs from singular periods in time. They may be updated periodically, but unlike real-time heat maps, they do not take hourly or daily temperatures. In some cities where static heat maps are available, the data necessary to populate the map was collected by volunteer citizen-scientists at different times of day and in different areas within a specific geographical region. Others incorporate census tracts within their maps to show which communities face the most risk of the urban heat island effect.

Analysis

DC Programs

In 2019, on one of the hottest days of the year, volunteer citizens gathered under the auspices of NOAA to measure the air temperature along prescribed routes throughout the District.[135] Researchers at Portland State University in Oregon then processed this data to create a color-coded map showing which areas of the city were hottest at certain times during the day. That map can be found **here**.

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135 *Science and Education Partners Reveal the Hottest Places in Washington, D.C., and Baltimore*, NOAA (May 24, 2019), **https://www.noaa.gov/education/stories/science-and-education-partners-reveal-hottest-places-in-washington-dc-and**.

Considerations and Tradeoffs

Economic

- In some instances, cities were able to source one-time data collection from volunteers, while in others, agencies or private companies outsourced their contracting.
- Regardless, the collection of temperature-related data is time consuming and must be completed regularly in order to keep an interactive heat map up to date and useful, unless there are permanent sensors in place that produce real-time data.

Environmental

- Incorporating specific data sets, such as tree canopy percentages, asphalt usage, impermeable surfaces, etc. can also help policymakers and city planners determine other policy options that can help to decrease temperatures in certain areas.

Social/Equity

- One of the most useful things about an interactive urban heat island map is that it is immediately available to those with access to a smart phone or the internet. However, lower-income households statistically have less access to these devices.[136]
- Even with these capabilities, some populations may not know how best to utilize this type of technology.

Administrative

- Ideally, interactive urban heat island maps can help citizens stay healthy during inclement weather events, while at the same time inform and assist policymakers as they make decisions regarding their weather emergency plans.

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136 Monica Anderson & Madhumitha Kumar, *Digital Divide Persists Even as Lower-Income Americans Make Gains in Tech Adoption*, Pew Rsch. Ctr. (May 7, 2019), **https://www.pewresearch.org/fact-tank/2019/05/07/digital-divide-persists-even-as-lower-income-americans-make-gains-in-tech-adoption**.

Participant Commentary

Other commentary:

- Participants didn't seem to be particularly aware of any sort of interactive heat mapping program that the District or any other City provided.

Potential policy or legislative solutions included:

- Heat maps, if created, should be made available to the public in a way that is easily accessible and user-friendly, so that the urgency of heat emergencies can be more widely known and spread.

Case Studies and Resources

Citizen Science: Mapping Urban Heat Islands in Richmond, Virginia

The urban heat island mapping project in Richmond, Virginia is a collaborative project that brings community members together to collect temperature variation data in order to design community-scale adaptation plans. Richmond is a highly populated city that has encountered increased urban heat island effect in recent years. While current technology such as satellites can provide city-scale urban heat data, a more detailed, block-by-block examination of temperature variation in each community has to be studied to understand which communities are most vulnerable to the extreme heat. "Citizen-scientists" were gathered to help measure temperatures in their own city, as well as related human activities or land use. The citizen-scientists included students from the University of Richmond and Virginia Commonwealth University, the Virginia Academy of Science, the City of Richmond's Sustainability Office, and Groundwork RVA—a nonprofit focused on empowering local young people in the communities.

CalEPA's Urban Heat Island Interactive Maps

The California Environmental Protection Agency has released an interactive urban heat map tool that shows heat islands throughout the state of California. Using Google Earth, the tool color codes the heat of cities according to intensity, with green at the lowest temperatures, and red at the highest. Temperatures were taken over the summer of two years—2006 and 2013. One of the outputs the map provides is an urban heat index, which quantifies the extent and severity of an urban heat island in a particular area within a city. Users can download the tool and corresponding data set to determine what areas of a City have a higher heat intensity, and how many people live in that area.

Extrema Paris Heat Map

The EXTREMA Project—funded primarily by the Directorate-General for European Civil Protection and Humanitarian Aid of the European Commission—is a mobile application that alerts its users if there is a high health risk in a certain area due to extreme heat, and directs the user to the nearest cooling facility or installation. To determine this health risk, the application uses real-time data regarding temperature, humidity, and discomfiture, which is updated every five minutes, and evaluates the risk to an individual user based on their personalized health information. Based on the user's location, the application then alerts the user to the nearest locations that can help them escape the heat, which can include tunnels, museums, parks, river banks, libraries, and more. Each of these locations are graded according to the relative coolness they will provide in comparison to the surrounding area.

National Integrated Heat Health Information System - Urban Heat Island Mapping Campaign

The National Integrated Heat Health Information System (NIHHIS) Urban Heat Island Mapping Campaign provides technical and financial support to urban areas to help them identify neighborhoods at greatest risk from heat stress. NIHHIS is an integrated system that develops science-based products and services for urban areas to understand and reduce health risks related to extreme heat, which is likely to increase in frequency and severity in many urban areas as a result of climate change. NIHHIS was developed through a partnership between the Centers for Disease Control and Prevention (CDC) and the National Oceanic and Atmospheric Administration (NOAA). The map provides a snapshot of relative heat across a city, but does not provide real time data on current temperatures. The presumption is that those neighborhoods found to be the hottest when the survey was done will continue to have the most heat during future high temperature events.

CONCLUSION

A successful Urban Heat Plan will require the implementation of the right combination of policy options. When used in conjunction with each other, these types of programs can help members of frontline populations "beat the heat" during heat waves. To determine which programs are appropriate, local governments would do well to reach out directly to the affected communities and get continual input from community leaders, individuals experiencing homelessness, low-income families, and those that are most at risk for heat-related health issues. Transparency and outreach are vital throughout the process and on a continuing basis in order to develop a heat plan that meets the needs of residents most at risk from extreme heat, and to ensure that residents are regularly informed of services and programs available to them that can help them cope with urban heat.