Heat Mitigation & Adaptation Guidebook

Strategies for Sedona

Prepared for the City of Sedona by CAPA Strategies, LLC

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Executive Summary

As climate change transforms cities and regions across the United States, rising temperatures threaten urban infrastructure, human health, and liveability. Although heat has not historically been a top priority in Sedona, it is addressed in the recent Sedona Climate Action Plan (2021), and the City is exploring opportunities to get ahead of rising temperatures. In 2023, the City of Sedona championed a Heat Watch mapping campaign, which showed heat distribution across the city. Of particular interest are the extent to which specific areas and populations are impacted by urban heat and how the City and Sedona community can build resilience.

Responding to heat will require a mix of mitigation (reducing temperatures and limiting heat exposure) and adaptation (coping when heat cannot be mitigated); physical, social, and policy interventions; and action by the City, professional partners, property owners, and community members. While some solutions can be quickly implemented, others will take months or years to put in place. Solutions exist at the household level and community-wide. As local leaders and residents plan for a hotter future, it will be essential to consider a range of heat mitigation and adaptation options, and select a complementary blend of solutions which meet immediate and long term needs. Ideally, heat mitigation solutions can integrate with existing priorities to address other environmental and health hazards (e.g., air pollution and stormwater runoff). This guidebook presents solutions which are supported by existing literature, and which are suitable for the steppe climate of Sedona.

Of the multiple solutions to mitigate heat, literature overwhelmingly emphasizes tree planting and preservation because trees offer numerous co-benefits such as air quality improvement, stormwater retention, flood reduction, improved neighborhood aesthetics, and increased property values. However, trees are not appropriate in all situations, nor are they the only available option for heat mitigation. In Sedona, a city positioned near the southwest Arizona desert and coping with regional drought, trees are not the most obvious line of defense, though they are one option. In addition to a summary of the benefits and challenges associated with trees, content will emphasize lesser known options which can support, replace, complement, or amplify a vegetation-based strategy. The guidebook includes ideas for maximizing the effectiveness and sustainability of various heat mitigation and adaptation strategies. This is not a prescriptive implementation plan, but rather an offering of potential solutions to help stimulate and structure ongoing conversations about extreme heat.

The content is divided into three sections:

Foundations

This section offers an overview of the climate and environmental challenges faced by Sedona, ideas for integrative climate solutions, and links to existing resources on related topics.

City Scale Strategies

This section covers high-level heat mitigation and adaptation strategies which are available to municipal managers and planners, non-profit or community based groups, academic institutions, commercial property owners, business owners, developers, utility companies, and other non-residential entities, as well as multi-family property owners or landlords. These are characterized as green infrastructure; built environment and infrastructure; funding, policy and legislation; education and engagement; and social support strategies. The strategies in this section are relatively more expensive and time consuming than those offered as 'Household Scale' strategies, make an impact at a larger scale, and pertain to heat mitigation as well as adaptation.

Household Scale Strategies

This section covers household-level strategies for responding to heat and building resilience. These strategies, which are available to all individual residents and homeowners, are relatively inexpensive, can be implemented on a short timeline, and pertain to heat adaptation rather than broad mitigation. Tips and existing resources for Sedona residents are linked at the end of this section.

Overview of the strategies included in this guidebook

Type	Heat Mitigation or Adaptation Strategy	Details
City Scale	Trees	Planting, maintenance, and preservation
	Green roofs	Vegetated systems
	Reflective and/or light colored materials	High albedo (reflective) roofs; Light colored walls, roofs, and pavements
	Open/green space	Grass or other vegetation; Community gardens; Urban agriculture
	Blue-green infrastructure	Bioswales; Vegetated retention ponds
	Cool pavement	Permeable pavement; Light colored pavement
	Pedestrian and active transportation infrastructure	"Complete Streets;" Bike lanes; Pedestrian safety improvements
	Shading	Non-vegetative shade structures; Solar arrays
	Energy efficiency updates	Weatherization; Retrofits (applies to all building types)
	Alternative energy systems	Solar; Geothermal; District cooling; Microgrids
	Legislation and policy changes	Funding; Tree maintenance; Public health
	Financial and technical assistance	Subsidies and rebates; Green infrastructure implementation and maintenance help
	Community education	Value of heat mitigation; Heat safety and risk
	Job training and volunteer corps	Activating community stewards; Building wealth in underserved communities
	Emergency response and resource giveaways	Heat emergency response plan; Cooling resources
Household Scale	Small-scale applications of City Scale strategies	Residential tree planting; Green, light colored, and/or reflective residential roofs and building materials; Home weatherization; Energy efficiency upgrades and alternative home energy sources
	Maximizing air flow	Strategic use of fans and windows
	Air conditioning	Air conditioners; Evaporative air coolers
	Insulation and venting	
	Shades, overhangs and window films	
	Self cooling and rest	Individual, health-based strategies

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Using this Guidebook

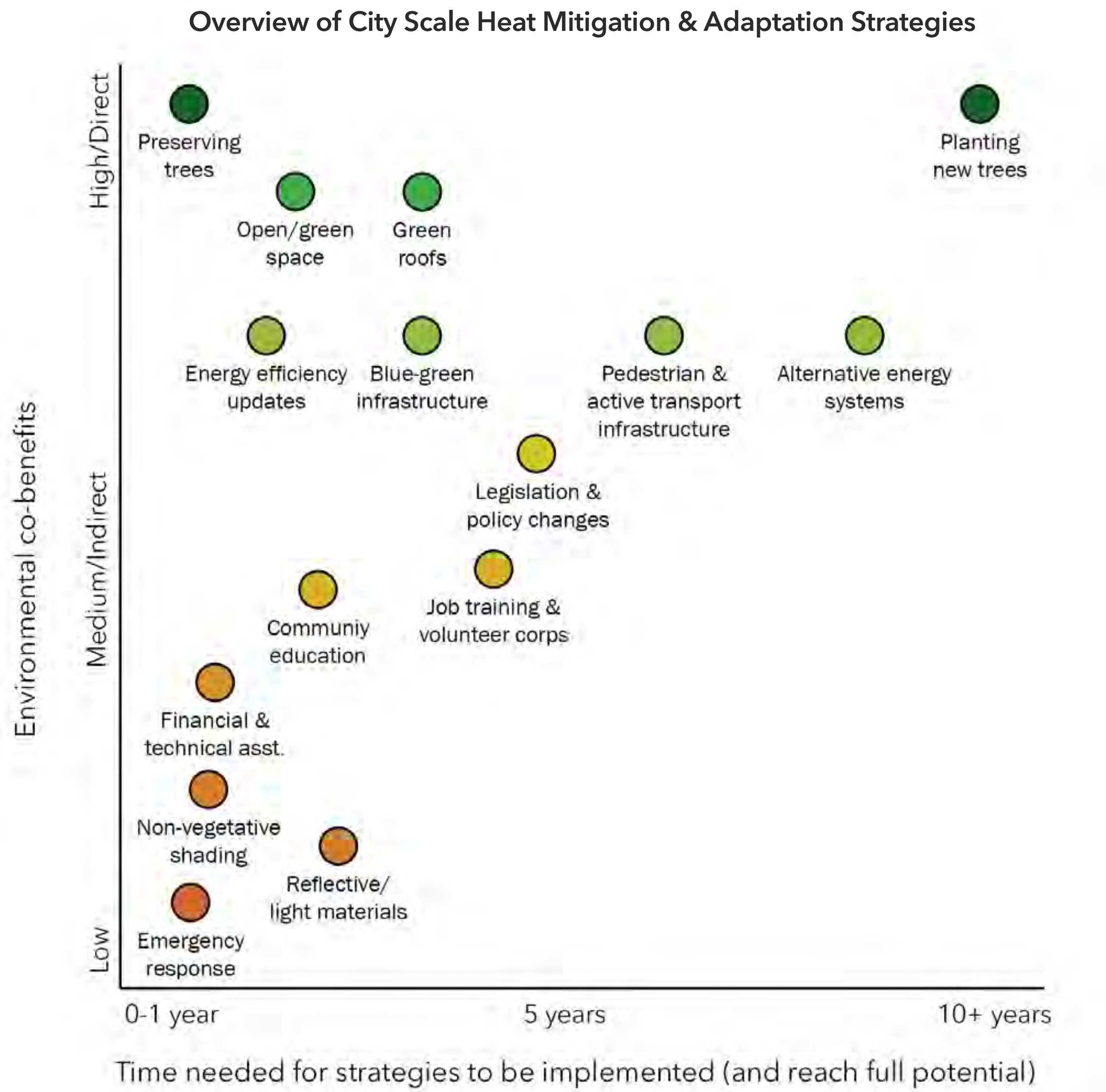
This guidebook is a resource for municipal staff, partners, and community members in Sedona which can help initiate and inform early conversations about heat mitigation and adaptation in the city. **Mitigation** measures are about reducing the presence and intensity of urban heat; for example, vegetating concrete surfaces to reduce heat absorption and the intensity of the urban heat island effect. **Adaptation** measures are about adjusting behaviors to cope with heat; for example, opening cooling centers so that unhoused residents have a safe place to cool off in the summer, or setting up portable shade structures to shield people from direct sunlight.

There are various options for addressing urban heat, and many nuances, best practices, costs, and benefits associated with each. The ideas presented here reflect a suite of concepts and interventions that have been selected for Sedona based on its specific climate and culture. Many of these concepts (e.g., green roofs, weatherization) are tried and true and have been positively assessed in both academic and practical literature; newer concepts (e.g., energy microgrids, "Complete Streets") show promise in the field of heat resilience and are growing in popularity. This guide offers an overview of select mitigation and adaptation options, as well as tips for increasing their efficacy, sustainability, and palatability. Municipal leaders, managers, planners and their professional partners are encouraged to use this information as a jumping off point, follow links and references, and dive deeper into the concepts that spark interest. This is not a prescriptive implementation plan, but rather an offering of potential solutions to help stimulate and structure ongoing conversations about extreme heat.

Chapter 1 covers foundational information on the climate of Sedona, relevant plans, and other resources. This content may be of interest to municipal planners and their partners, as well as city residents.

Chapters 2-6 cover heat mitigation and adaptation approaches which could be initiated, funded and managed at the citywide scale. These 'City Scale' strategies are primarily intended for managers and planners, non-profit or community based groups, academic institutions, commercial property owners, business owners, developers, utility companies, and other non-residential entities, as well as multi-family property owners or landlords.These chapters include heat mitigation and adaptation opportunities. The strategies in this section are relatively more expensive and time consuming than those offered as 'Household Scale' strategies, and make an impact at a larger scale.

The chart below offers a characterization of the City Scale strategies covered in this guidebook, including timeline (horizontal axis) and environmental co-benefits (vertical axis). Timeline refers to the approximate amount of time required to implement a heat mitigation or adaptation intervention, and when applicable, the time required for that intervention to reach its full potential. Environmental co-benefits refer to natural hazards and needs other than heat which could be addressed by these solutions. Co-benefits considered here include those related to stormwater and flood management, air quality, carbon capture, and wildlife habitat, all of which could emerge directly as a result of specific heat-related interventions. Some measures do not have direct environmental benefits, but could contribute to them indirectly; for example, job training could lead to improved maintenance of trees, and trees produce co-benefits related to air quality, habitat, and stormwater management. Those measures are identified as having medium/indirect co-benefits in the chart. All representations are generalized estimates and relative to the other solutions presented here. The extent and details of any intervention in practice may increase or decrease its timeline and benefits. This graphic should be used only as a conceptual aid.



Chapter 7 is intended for use by city residents as it covers 'Household Scale' strategies, though the content may also be used by entities working at the City Scale to frame outreach and education. This section covers individual, household-level strategies for responding to heat and building resilience. These strategies are relatively inexpensive, can be implemented on a short timeline, and favor heat adaptation rather than broad mitigation. The final section (7.6) directs readers to existing, user-friendly resources with tips for heat preparedness, safety, and coping mechanisms.

1: Background

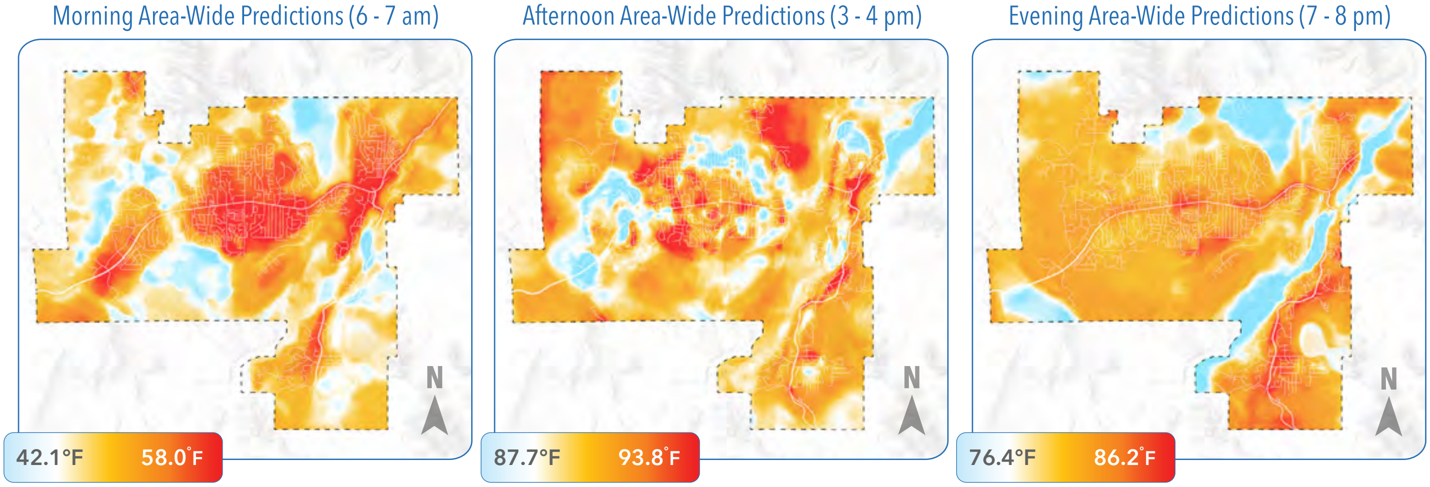
1.1 Climate and environmental conditions in Sedona

Sedona, AZ is located in a transitional climate zone called a steppe, also known as 'Bsk' in the Koeppen-Geiger classification system (Koeppen-Geiger, 2024). Steppe climates typically occur on the periphery of a desert climate ('Bwh') and are often at a transition point with a warm mediterranean climate ('Csa'), as is the case in Sedona (Britannica, 2024). Steppes display distinct temperature differences between summer and winter seasons, and are typically semi-arid with low humidity (National Geographic, 2024). Their water needs can be met largely by precipitation. However, water shortages or needs for supplementation can still exist, particularly if a steppe city is located in proximity to a desert or within a drought-prone region. In the case of Sedona, heat-related interventions that are suitable for a Bsk, Csa, or Bwh climate may be potentially applicable.

As in many cities worldwide, weather in Sedona is predicted to undergo a shift, including rising temperatures (NOAA, 2024). While some Arizona locals consider Sedona relatively cool compared to cities like Phoenix and Tucson, temperatures there periodically exceed 90 or 100°F. In June through September of 2023, Sedona experienced 76 days at or above 90°F. Of those, 18 days were over 100°F, including 17 days in July. The maximum temperature recorded was 108°F (Weather Underground, 2024). Like all cities, Sedona is prone to the 'urban heat island' (UHI) effect (Taha, 1997). This means that impervious surfaces absorb heat from the sun while concentrated human activities, such as driving and using air conditioners, add heat to the air, leading to higher temperatures in heavily developed areas.

Consistent summer temperatures in the upper 80s to 100s pose a potential threat to human health and quality of life. Extreme heat has been tied to increased levels of anxiety, depression, and aggressive behavior (Burke et al., 2018; Miles-Novelo & Anderson, 2019), and can be especially devastating to the physical health of infants and young children, adults over 65 years old, those who work or live outdoors, and those who are socially isolated (Gronlund, 2014). Visitors to the area who are not acclimated to conditions in Arizona may be at particular risk. Sustained, elevated internal body temperature can trigger major health events like heart attack or stroke for those with preexisting health conditions such as cardiovascular disease and diabetes (CDC, 2024a; Gronlund, 2014). Even those in relatively good health can succumb to heat stress or heat stroke, the latter of which can be fatal if left untreated. This is a problem especially affecting athletes and laborers who exert themselves in outdoor heat (CDC, 2024b; Coris et al., 2004), children playing outdoors, and, in the case of Sedona, tourists recreating outdoors. Individuals unaware of the severity of heat risk or the signs of heat-related illness may fail to rest, cool themselves, or seek medical attention at critical moments.

A recent study by the City of Sedona and CAPA Strategies shows that in Sedona, as in many US cities, heat is not evenly distributed. The city center is more built out, less vegetated, and thus experiences disproportionately high temperatures compared to less developed areas. The heat is especially pronounced around US Route 89, which cuts through the city. Compared to other natural hazards like flooding, heat generates little physical-infrastructural damage except in the most extreme cases. However, heat waves kill more people each year than all other natural disasters combined, and sustained temperature increases – not just short-lived heat waves – can have widespread public health consequences (National Weather Service, 2024).



Morning, afternoon, and evening area-wide models for distribution of near surface temperature (°F). Source: CAPA 2023 Heat Watch

1.2 Integrative heat mitigation and adaptation solutions

The City of Sedona recognizes the importance of targeted heat-related interventions, though cooling solutions need not be separated from ongoing efforts pertaining to climate change mitigation, greenhouse gas reduction, or environmental management. There are numerous opportunities for heat mitigating infrastructure to control stormwater flow and flooding (see chapter *2 Green infrastructure*); to mitigate harmful emissions and air pollution (see chapter *3.2 Transportation infrastructure*); and to alleviate the cost burden associated with commercial and residential energy use (see chapter *3.4 Energy*).

Integrative solutions are highly recommended as a way to maximize the impact of each intervention, minimize redundant work and wasted resources, and tackle climate change as the complex challenge that it is (United Nations Environment Programme, 2021). From a municipal standpoint, heat-related interventions that serve a dual function may be easier to fund because they are a better value than standalone, single-stressor interventions; they may be covered under existing policies and programs pertinent to water management, urban forestry, or environmental health, perhaps reducing the need to pass new legislation; and they may more easily attain community buy-in as they appeal to multiple interest groups. For many of the suggestions provided in this guide, integration and multifunctionality are inherent. However, the City and its partners will need to be intentional in framing heat-related interventions such that those multiple benefits are well understood by funders, the public, and local decision makers. Intentional approaches which link climate adaptation and heat-related action with public health have been particularly popular (Berisha et al., 2017, Casati et al., 2013).

Given that the City's Sustainability Program and public discussions of climate change and urban heat are relatively new in Sedona, municipal staff, decision makers and residents may not be fully on board with proposed changes or new requirements. Rather than unveil actions one by one, the Sustainability Program might consider a cohesive sustainability plan for the city that incorporates heat-related content and ties environmental issues to people's daily concerns and experiences. Additionally, the Sustainability Program might consider opportunities to coordinate with complementary programs such as Community Development (Building, Planning) and Public Works from the start to ensure that proposed intervention strategies are actionable.

1.3 Existing resources

This guidebook focuses specifically on options for heat mitigation and adaptation in Sedona. Such interventions fit into the bigger picture of climate change preparedness, though this guidebook will not delve into climate change adaptation, vulnerability, planning, or mitigation generally. For information on related topics, please refer to the following resources:

- Sedona Community Plan (2024)
- Sedona Climate Action Plan (2021)
- City of Sedona Municipal Sustainability Plan (2020)[1]
- Sedona Land Development Code (2019)
- City of Sedona Sustainability Program webpage

[1] This plan is undergoing an update as of April 2024

2: Green Infrastructure

2.1 Trees

Benefits of trees

When cities and communities are planning for heat mitigation and adaptation, trees are a popular choice for green infrastructure (GI), even in water-scarce regions of the west and southwest. This is because trees are uniquely effective at cooling urban environments, mitigating the urban heat island effect, and providing a suite of complementary social and ecological advantages. Trees are an example of a nature-based solution, an approach to climate adaptation which integrates natural features into the built environment. Nature-based solutions are considered more sustainable and cost effective than traditional infrastructure solutions, and simultaneously benefit humans and broader urban ecosystems by working with, rather than against, nature (Cohen-Shacham et al., 2016).

Trees cool the air through the process of evapotranspiration, whereby vegetation releases moisture into the atmosphere (Qiu et al., 2013). This effect is most profound among large stands of trees, such as in dense forests surrounding the city or within well-vegetated parks. Even in smaller quantities, trees provide shade which gives refuge to pedestrians and other commuters as well as those working or recreating outdoors, and keeps outdoor surfaces from absorbing solar radiation. Trees also shade buildings, which reduces the need for energy use to cool indoor spaces. Heat mapping conducted in Sedona in 2023 showed that some parts of the city – those least vegetated and suffering the most severe impacts of the urban heat island effect – were up to 16.4°F hotter than the coolest parts. Mapping in comparable climates – San Diego, CA; Albuquerque, NM; Boise, ID; and Salt Lake City, UT – has also revealed double-digit temperature variations within cities largely consistent with variations in tree cover and other vegetation (CAPA Strategies, 2024).

Besides contributing directly to urban heat island mitigation and climate adaptation, trees make urban environments more liveable and aesthetically pleasing, improve health outcomes, increase property values, and reduce crime. They provide wildlife habitat and contribute to biodiversity, clean pollutants such as particulate matter and ozone from the air, filter water, and prevent erosion and flooding (National Wildlife Federation, 2024).

Limitations of a tree-based strategy

Despite their many benefits, trees are not appropriate or desired in every situation. In a steppe climate like Sedona, annual precipitation cannot support a wide variety of tree species and is more conducive to lower-lying vegetation. New tree planting in the city requires the installation of new irrigation systems, which may be prohibitive. Furthermore, trees alone may be unable to satisfy all of a community's interests related to cooling. This means that planners will need to consider alternative solutions for heat mitigation and apply them as needed. Generally speaking, major limitations of a tree-based strategy include:

- City residents may be reluctant to plant trees for a variety of reasons. Common concerns include the upfront costs associated with tree planting and maintenance, the cost of watering, and debris or property damage from fallen fruit, leaves, and limbs. Homeowners may not appreciate a tree's broader value to themselves (e.g., future energy savings and increased property values) and their community. While concerns could be overcome through outreach and education in some cases, not all property owners will welcome trees (Riedman et al., 2022).
- Trees require consistent maintenance for their first few years as they put down roots and get established. After establishment, periodic watering and pruning are required. While municipal, private, or non-profit funds may allow for widespread planting efforts, project plans and budgets often fail to account for the ongoing maintenance needs of trees. With no designated party responsible for upkeep, or no funds available to support them, new trees can die before reaching their full potential, or within just a few years of being planted (Pincetl et al., 2013; Widney et al., 2016). In Sedona, an 8b hardiness zone, new trees will take approximately six months to grow each inch of trunk diameter (University of Florida, 2020).
- Urban areas which have been heavily developed may lack space for new trees. Making space requires major changes to the built environment such as de-pavement, or the taking of land already in use for another purpose. These kinds of changes can be costly, politically difficult, and logistically challenging to implement.
- Trees compete for land area with equally valuable uses like homes and businesses. Climate mitigation efforts may depend on placing homes and businesses in closer proximity to each other (i.e., increasing density and limiting sprawl), leaving less open space for trees.
- The presence of power lines and utility lines – including those underground such as water, sewer, stormwater, and gas – creates a conflict and limits the potential placement options for new trees.
- Trees have been shown to increase property values, which is usually thought of as a benefit. However, studies have also shown that the uneven installation of green infrastructure (including trees) within cities can sometimes lead to a process called 'green gentrification' years later (Anguelovski et al., 2022; Gould & Lewis, 2016). In these cases, green amenities in previously underserved areas can trigger an increase in property values, taxes and rents, attract new businesses and residents, and lead to the displacement of longtime residents. If not addressed intentionally by city planners and policy-makers, this outcome could harm those communities who were meant to be served by greening.

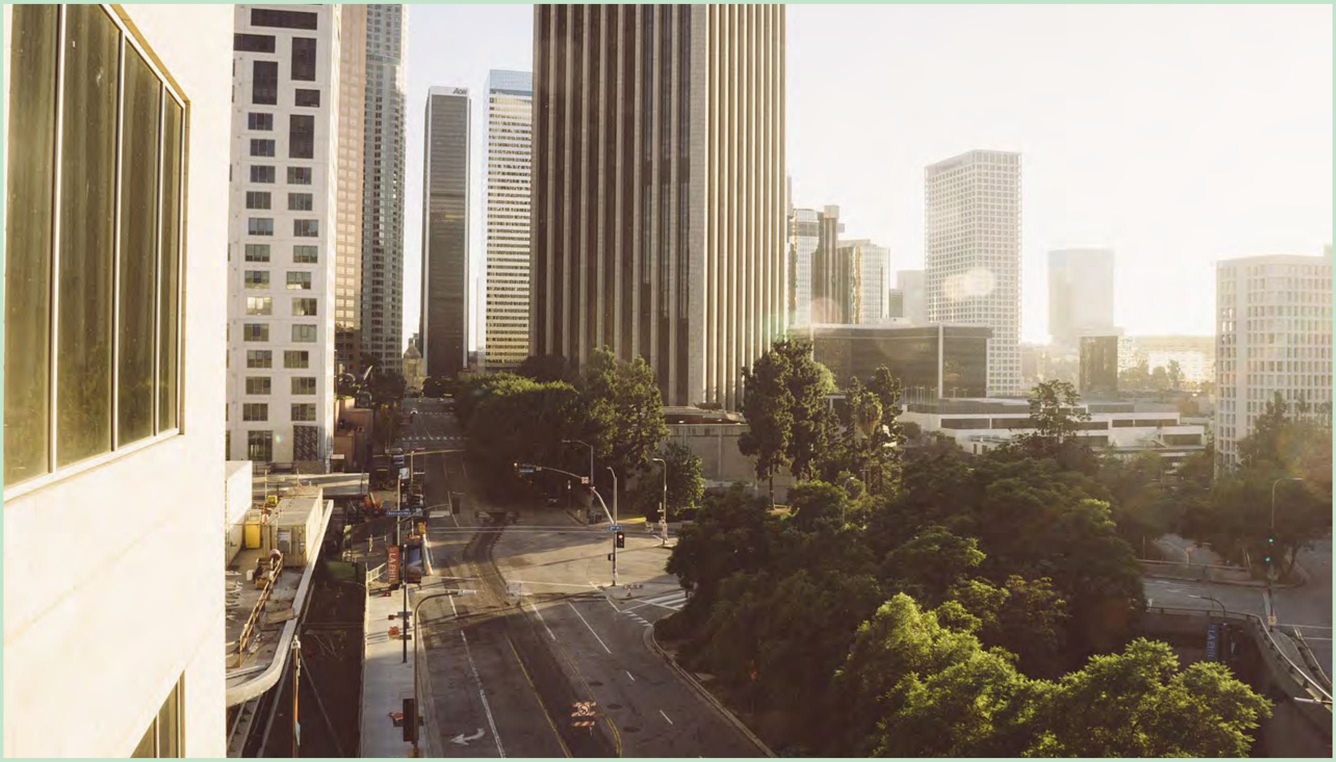
Making the most of trees

When trees are utilized for heat mitigation (and other environmental purposes) there are several steps that can be taken to increase the chances of success and sustainability.

- Native species are preferable because they are climate adapted, require limited water, and complement other natural components of the urban ecosystem. Currently, the Sedona municipal code (2024) requires that at least 50% of plants on new developments be native species.
- Deciduous trees provide the most effective shading and cooling in the summer, while allowing sunlight exposure in colder months when leaves fall (Antoszewski, 2020; National Wildlife Federation, 2024). This means that deciduous tree-shaded buildings can enjoy low cooling burdens in the summer without added heating burdens in the winter. Native deciduous trees approved by the Sedona Land Development Code (2019) include Netleaf Hackberry, Desert Willow, Velvet Mesquite, Gambel Oak, and Western Soapberry among others, as well as several riparian species. In addition to native trees and shrubs, the Land Development Code provides a list of "adaptive species" suited to local conditions.

- Due to climate change and possible changes in pest activity in the region (e.g., bark beetles, oak borer beetles), some native tree species may become less suitable over time. It is recommended that the City of Sedona devise a list of native and non-native species which can survive in projected future conditions and plant them as conditions become appropriate. The existing list of 'Adaptive Trees' within the Land Development code may be expanded for this purpose.

- The right configuration of trees will depend on communities' goals and the urban context. A combination of configurations across the city may be most appropriate and feasible. A cluster of trees in a single location (e.g., a forest) offers greater benefits in terms of air purification, stormwater control, and localized heat mitigation; while the same number of trees spread equally over a large area (e.g. an entire city) will have less pronounced long-term ecological effects, but will positively impact a greater number of urban residents in the short term (Heynan, 2003). Street trees distributed in densely populated urban areas have a greater effect on thermal comfort than do trees clustered away from human activity zones (Kong et al., 2017; Wang et al., 2021a).
- In Sedona, given requirements to install irrigation systems with newly planted trees, it may be most cost-effective and practical to plant trees in clusters that can share a single system (Roman et al., 2015).
- When combined with blue infrastructure such as a body of water (natural or manmade), the cooling effect of trees is enhanced. A recent study by Teshnehdel et al. (2022) modeled the cooling power of water bodies and trees in a steppe climate, and found that the optimal summertime arrangement for cooling consisted of 36% trees, 27% water body, and 21% pavement. The modeled area without trees and water had a thermal index as high as 37.5°C (99.5°F) compared to 23°C (73.4°F) with trees and water. More information on combined blue-green infrastructure is available in section 2.3. Following on from this study, the City might undertake scenario modeling to better understand the potential thermal impacts of interventions in Sedona, tree-based or otherwise.
- Engage with local communities and obtain public buy-in from the start to ensure that tree planting projects respond to their interest and needs, that trees will be welcomed and cared for, and that greening does not place an unintended burden on community members (deGuzman et al., 2018). Direct engagement with residents and property owners may allow the City to leverage a cache of privately-owned planting space – including residential yards, parking lots, and commercial landscapes – which could be planted and maintained by those property owners.
- With any major tree planting initiative, plan for at least three to five years of monitoring and maintenance, including a regular watering schedule. This plan should clearly designate the responsible entities and funding source to cover maintenance staff salaries, tools and equipment, water, and logistical planning (e.g., establishing an annual rotation for pruning). Longer term maintenance programs may also be needed, particularly if mature trees decline under hotter, drier conditions. Assessments from Portland, OR (Davey Resource Group, 2009) and Los Angeles, CA (Hellman et al., 2024) indicate that a robust tree maintenance program could cost ten of millions of dollars, though the exact price will vary depending on city size, cost of labor, number of trees, and other factors. Options for funding can be found in *chapter 4.1*.
- Consider tree-based heat mitigation strategies which prioritize the preservation of mature canopy as well as new planting. Fully grown trees are up to 70 times more effective than saplings at capturing carbon, mitigating heat, and controlling stormwater (Stecker, 2014; Treekeepers of Washington County, 2024).



Case Study:

CASE STUDY: URBAN FORESTRY IN PHOENIX, AZ & LOS ANGELES, CA

Trees may not seem an obvious choice for a water-scarce region, but the value brought by trees arguably justifies the use of water resources to maintain them. In Phoenix, a hot, dry desert climate, the City is working to create "cool corridors" by planting and preserving thousands of urban trees. The Mayor has expressed a desire to plan 100 "cool corridors" – high-traffic walkways and streets with copious tree shade – by 2030. Tree planting efforts in Phoenix were recently bolstered by a federal grant worth $10 million. The City is focusing on shade equity for low-income neighborhoods, cool schools, lower home energy bills, and a better quality of life for all (American Forests, 2024a; City of Phoenix, 2022; Tanet, 2023).

In Los Angeles, which, like Sedona, sits at the transition point between a steppe and warm mediterranean climate, City leaders are making a strong push to expand the urban forest. The Mayor's Green New Deal calls on the City to increase canopy cover by at least 50% in the lowest-canopied neighborhoods, despite pervasive challenges with space, maintenance capacity, and water (City Plants, 2024). In 2019, the City hired its first Urban Forest Officer, who is tasked with the management of tree planting, preservation, and urban forestry planning (City of Los Angeles, 2024).

2.2 Green space and vegetation

Green roofs

- Green roofs can serve a mild heat mitigation function, and provide stormwater capture, wildlife habitat, and/or beautification. The plants used should be suitable for the climate, low-lying, and require minimal watering such as water-wise landscaping selections.
- The presence of green roofs has a minimal impact on ambient outdoor temperatures at the pedestrian level, though can reduce localized air temperature by up to 5°F (EPA, 2024a). Green roofs and walls can effectively reduce indoor temperatures, and offer insulation which reduces energy burdens for cooling. However, a review of green roof literature by Jamei et al. (2023) found that the energy savings for hot-dry climates like Sedona was less than that for temperate climates, ranging from approximately 2-23% savings in energy consumption.

Considerations:

The City of Sedona does not restrict businesses or residents from installing green roofs on their properties. However, it may be beneficial for the City to lead by example and demonstrate the concept by first installing green roofs on its own facilities. Doing so may require maintenance and updates to older structures that are unable to support the added weight of a green roof.

<u>Open/green space</u>

Vegetated open spaces, typically found in the form of urban parks or plots of grass, are less effective than trees but more effective than green roofs at reducing the UHI effect and outdoor surface temperatures (Liu et al., 2022).

- Open, green spaces are most effective for cooling when they appear in compact and simple shapes such as a circle or square (Gherraz et al., 2020).
- Community gardens and urban agriculture sites can also serve as cooling green spaces and, depending on the density and type of vegetation, may serve a greater cooling function than grass-only spaces. These sites offer the added benefit of food production and community building for those who live in the area. Rainwater harvesting on-site offers a sustainable option for watering trees, crops, and other vegetation (EPA, 2024b).
- Adding green space to existing parking lots in Sedona could be a relatively easy option for increasing vegetation coverage. If trees are not viable, low-lying native plants could be installed within or surrounding paved spaces. While they may not provide shade, vegetation will yield cooler surface temperatures and reduced heat absorption compared to concrete or asphalt.

2.3 Blue-green infrastructure

The Sedona Community Plan (2013) includes a chapter on Environment, which sets out the following goal: “Reduce the impacts of flooding and erosion on the community and environment.” The 2013 version and 2024 update highlight negative impacts of flooding on water quality in Oak Creek and on local properties. Additionally, the City’s Public Works Department contends that pollution from stormwater runoff is more pronounced due to how little precipitation Sedona receives, stating, “Low amounts of precipitation results in higher concentrations of pollutants during each rain event as compared to cities in less arid regions” (City of Sedona, 2024a) Combined blue-green infrastructure (BGI) can simultaneously address concerns related to urban heat and flooding.

- Blue or paired blue-green infrastructure (BGI) is commonly thought of first as a stormwater management solution, and is therefore favored in any climate that is challenged by flooding.
- Forms of BGI such as bioswales and vegetated retention ponds reduce the prevalence of impervious surfaces and potentially increase the presence of vegetation in the city, thus contributing to an overall reduction in the urban heat island effect and outdoor temperatures while controlling stormwater (Liao et al., 2017).
- Water features alone can cool air temperature in a steppe climate. Trees have been found most effective for cooling when located near a body of water, whether natural or manmade (Teshnehdel et al., 2022). It is recommended that GI and vegetation be placed near water features, such as fountains, lakes, ponds, pools, or rivers when possible to maximize cooling benefits.
- Other blue infrastructure solutions which serve the purpose of heat adaptation include drinking fountains and/or water bottle refill stations in high-traffic public places, misting stations (permanent or seasonal/mobile), and splash pads in city parks.

Considerations:

As with trees, all forms of green and blue-green infrastructure require regular and ongoing maintenance (Lamond & Everett, 2019). Plans for maintenance, including funding, should be put in place prior to the implementation of any new (B)GI projects. This may require coordination between departments such as Public Works and Parks & Recreation. Although (B)GI can mitigate urban heat, proposed projects might highlight its flood mitigation benefits. Flooding is a more expensive and physically damaging environmental stressor than heat and may receive greater interest from decision makers or funders.

Rocky ground beneath much of Sedona means that bioswales and retention ponds may not be the most effective choice in all places. Locations should be carefully chosen based on drainage.

3: Built Environment & Infrastructure

3.1 Building and development codes

Buildings

The hard, impervious, built-out quality of urban areas is a key factor in the development of the urban heat island effect, whereby urban structures trap heat and release it slowly throughout the day and night. Large buildings (e.g., commercial or residential high rises, office parks, university facilities, shopping centers) are ubiquitous in urban areas, contribute significantly to the urban heat island effect, and are therefore a logical target for heat mitigating interventions. Often, cities achieve changes to the built environment by imposing new building codes, requiring sustainable practices and certifications, such as LEED or Energy Star. However, because Arizona is subject to the Dillon Rule, which prevents deviation from statewide building standards, Sedona is limited in its ability to impose new codes. The State of Arizona has adopted the 2018 International Building Code (IBC) and accompanying International Energy Conservation Code (IECC), the latter of which sets efficiency and building envelope standards for new commercial construction. The IECC suggests minimums of roof reflectivity, but does not mandate specific efficiency certifications such as LEED, cool building materials, or retrofits to existing buildings. If City staff would like to see efficiency and sustainability standards implemented for new developments, options to work around the Dillon Rule include:

- Focus on incentivizing, rather than mandating, green building practices. This can be done, for example, by offering a density bonus for large buildings, or waiving permitting or development fees when developers comply with LEED or similar standards.

- Establish a green building fund to help the owners of existing buildings pay for retrofits and sustainable upgrades. This can be paid into by developers whose new properties do not conform to green building standards.
- Mandate performance outcomes rather than building codes. In other words, the City can mandate that all buildings meet certain efficiency or heat mitigation goals by a future date without mandating that property owners take specific actions to reach those goals. This approach may be established through a resilience zoning ordinance (see case study example below). In order to allow a variety of new and old structures to meet resilience zoning criteria, offer a flexible menu of options that developers and property owners can choose from.

Sustainable building goals include:

Cool roofs and vegetation

Incorporating green spaces means that buildings will be cooler inside and require less energy use, that stormwater will be better captured and retained in highly developed areas prone to runoff, and that habitat is provided for birds and other wildlife.

- New developments incorporate eco roofs (also known as green roofs), and/or provide adjacent, ground-level vegetated space and landscaping maintenance, either on private grounds or in the public right of way.
- New developments requiring the removal of mature trees incorporate a minimum number of replacement trees on the property.
- Reflective and/or light colored roofing materials are an alternative to green roofs, theoretically provide similar indoor cooling benefits, require less regular maintenance, and may be suitable for older buildings or those that cannot support the weight of a green roof. However, reflective and light roofs do not contribute to stormwater management or provide habitat.

Energy use and emissions

- The City may create conditions that encourage building owners to meet energy efficiency standards, and to achieve or work toward net zero emissions within a reasonable time frame.
- Incentives and regulations based on efficiency may encourage developers and property owners to pursue clean energy systems, implement passive cooling measures, and utilize heat-mitigating solutions such as green or reflective roofs which improve indoor conditions on hot days. A reduction in energy use contributes to a decrease in carbon emissions and overall warming.

Considerations:

New building standards and incentives as described are more easily applied to new structures, though older buildings are also in need of retrofits and energy efficiency upgrades. Owners of existing buildings may respond to education and outreach, or opt for upgrades with financial support.

It may be difficult to implement green roofs or adjacent vegetation on or around existing buildings if an older structure cannot support the weight of a green roof, or if there is no adjacent space to work with. Such strategies could be applied to new buildings, while older buildings can more readily comply with reflective and/or light colored roofing or energy efficiency standards.

Although reflective and light colored roofs are considered to be an effective strategy for reducing indoor temperatures (US Department of Energy, 2024a), large structures in Sedona must apply for a variance to deviate from the city standard for roofing, including proving that a reflective or white roof will actually result in energy savings.

Standards and incentives which encourage new developments to incorporate trees or green space will not be effective in the long term if no agreement is made regarding maintenance and upkeep. If a developer cuts down mature trees and replaces them with saplings which are allowed to die within a few years, the positive effects on heat mitigation will be negligible (Widney et al., 2016).

Case Study:

OVERCOMING THE DILLON RULE IN ARLINGTON COUNTY & NORFOLK, VIRGINIA

Arlington County has successfully navigated the Dillon Rule limitation by incentivizing, rather than mandating, green buildings for over two decades. The County encourages compliance with green building best practices by offering a density bonus – which allows developers to get more out of a limited space – to new developments achieving LEED and/or Energy Star certification. The County has also established a Green Building Fund. New developments that do not comply with LEED standards are assessed a fee, and the resulting fund is used to provide education and support to developers engaged in green building practices (Arlington County, 2020). Norfolk has recently adopted a resilience zoning ordinance which requires developers to achieve a "resilience quotient" by gaining "points" through sustainable building practices. Developers who do not meet new standards are subject to a more intensive site review process (Pew, 2019). Although Norfolk's approach emphasizes coastal flooding resilience, the same strategy could be applied with an emphasis on heat.

Cool pavement

- There is a growing body of evidence to support the use of various "smart surfaces" in urban development, including permeable and light colored pavements. Extensive guidance on this topic can be found in the Smart Surfaces Guidebook (2022), assembled by the Smart Surfaces Coalition.
- Permeable pavements absorb stormwater runoff, and can be made of porous materials that hold less heat than traditional concrete, making walkways more comfortable for people and pets. Light colored pavements, including light gray or white concrete, provide similar benefits by absorbing less heat throughout the day than darker alternatives such as blacktop. Both may be suitable options for various locations in Sedona, such as parking lots, private driveways, school campuses, or walking and biking baths.

Case Study:

REFLECTIVE PAVEMENTS IN PHOENIX, AZ & LOS ANGELES, CA

Reflective pavements – on roadways, sidewalks, and parking lots – is an experimental option for urban heat mitigation. The concept assumes that high albedo surfaces will reflect heat away from paved surfaces, limiting the absorption of solar radiation and lowering surface temperatures. This has proved to be true according to pilot projects in Phoenix where, for example, a blacktop parking lot measured 209°F before application of a reflective coating and 135°F after (Smart Surfaces Coalition, 2022). The City of Los Angeles tried a similar approach, applying a covering called CoolSeal to select residential roads. Subsequent studies in both cities found that cool pavements had the unintended consequence of making the ambient environment hotter, actually increasing thermal discomfort for pedestrians by approximately 5-7°F in sunny conditions. This is because the solar radiation reflected off of pavement bounces onto pedestrians (Arizona State University, 2021; Bloch, 2019). Given the trade-off between pedestrian comfort and effects on UHI by reducing surface temperatures, reflective or high albedo pavements are not necessarily an advisable strategy. If used, reflective coatings might be applied only in areas with low pedestrian traffic.

Consideration:

Sedona's Development Code requires that the City use a "red rock" colored pavement for all sidewalks in order to maintain the character of the city. Any changes to this requirement would need to be voted on by the City Council.

3.2 Transportation infrastructure

Like buildings, automobiles are ubiquitous in urban areas and exacerbate the urban heat island effect locally, while contributing to emissions, warming, and air pollution at a larger scale. Prioritizing public and alternative transportation in Sedona is a way to simultaneously mitigate heat, reduce emissions and air pollutants, and promote community health via active transportation (Glazener & Khreis, 2019). Encouraging more active transportation in the future – which can improve human health and mitigate urban heat as well as harmful air quality – requires a careful elevation of alternative options.

Specific strategies include adding new bike lanes to larger thoroughfares, and/or designating select small roads as bike-only thoroughfares closed to non-resident traffic; creating safe walking paths; and increasing the reach of shuttle routes and frequency of trips. "Complete Streets" design policies are growing in popularity with many examples nationwide (Smart Growth America, 2024), and guide the integration of pedestrian- and alternative transportation-friendly infrastructure into urban development (Jordan & Ivey, 2021). A pending update to the City of Sedona's Community Plan (2023) identifies "Complete Streets" as a goal and articulates the fact that residents feel that "transit is for visitors, not residents" (Perry, 2024).

Greater opportunities for public and active transportation mean more time spent outdoors in the heat and, in the case of active transportation, increased physical exertion. This also means that upgrades to pedestrian and commuter heat safety infrastructure will be needed (Karner et al., 2019). Examples include providing shade at shuttle stops, and placing public water fountains or misting stations along popular commuter routes (Lanza & Durand, 2021). Additional tips include placing new bike or walking paths close to existing tall buildings or trees, which provide shade; and utilizing permeable and/or light pavements along pedestrian and bike paths to cool the path surface and assist with stormwater capture (United Nations United Nations Environment Programme, 2021).

Considerations:

Any expected increases in the frequency of active transportation (walking, biking, skating, etc.), should be coupled with appropriate public health messaging and safety warnings during high heat events, particularly when wildfire smoke or air pollution concentrations are also high.

"Complete Streets" policies often call for trees or other street vegetation to provide shade and reduce the UHI effect. If funding and capacity for street tree maintenance are limited, or if there are unclear roles related to public tree care, such changes may be difficult to implement or maintain. As noted in chapter 2, new planting projects should plan for multiple years of tree care.

3.3 Non-vegetative shading

Offering people, pets, surfaces, and structures the opportunity to avoid direct sun exposure is an effective way to reduce heat stress and the UHI effect. Large trees create shade while offering environmental co-benefits, though as noted in chapter 2, capacity and water resource limitations could create maintenance challenges for City of Sedona staff. Trees also may not be a good fit in all high-traffic areas, such as sidewalks or other paved spaces, and areas without proper soil, drainage, or irrigation. Non-vegetated shade structures serve a similar heat mitigation function but require less upkeep compared to trees and have a more immediate cooling impact.

Tips for effective shading (United Nations United Nations Environment Programme, 2021):

- Prioritize busy commuter routes for shading upgrades (Jay et al., 2021). Areas where people congregate, such as playgrounds and picnic areas, can also be prioritized for shading.
- Aim for at least 30% shade coverage along transit paths, and consider how shade structures will behave at different times of day and with different sun angles.
- Shade areas where individuals will be resting or waiting (benches, shuttle stops). Pergolas and shade canopies are popular options for this purpose.
- Note that paths or sites with east-west exposure will require more shading than those with north-south exposure.

Studies of different types of shade in both Phoenix and Tempe, AZ have found that although artificial (i.e., non-tree) shade structures are not always as effective as trees at improving thermal comfort, they are nevertheless cooling (Colter et al., 2019; Middel et al., 2021). A city like Sedona could benefit by pursuing a mix of shading solutions based on variation in local conditions, space availability, and other factors; in other words, choosing the "right shade in the right place." Options include removable fabric canopies, shade sails, umbrellas and awnings, as well as permanent installations such as transit stop shelters and parking space covers (Maricopa Association of Governments, 2024a).

Permanent shade structures can provide co-benefits when outfitted with a green roof or solar panels. The aforementioned study in Tempe, AZ found that engineered, photovoltaic (i.e., consisting of solar panels) shade structures were more effective than trees at reducing daytime thermal comfort, lessened peak demand on the energy grid, and helped conserve water. Large installations in parking lots, at transit centers, at medical facilities, or on school campuses may be particularly effective at reducing outdoor heat exposure in locations where people are commonly susceptible. There is a significant amount of parking space available in the city and at surrounding recreational destinations, including several parking lots in Uptown Sedona, that could host solar shade installations.

Case Study:

SOLAR TREES IN SAN DIEGO, CA

In 2008, the University of California San Diego (UCSD) installed solar arrays, with individual structures called "Solar Trees," in two campus parking lots. Solar Trees provide shade to parked vehicles and can be equipped with electric vehicle charging infrastructure. Surface temperatures under the shade of these installations measure 20°F cooler than a typical, uncovered parking lot. Each Solar Tree is capable of generating 17,000 kilowatt hours of solar electricity per year, which can be used on the campus (Nagel, 2008; Smart Surfaces Coalition, 2022). Supplemental energy sources like this allow the University to reduce its demand during peak usage times and potentially reduce stress on the city's main power grid. The successful solar installations at UCSD remain in place after 15+ years.

Considerations:

The City of Sedona received pushback when attempting to mandate covered parking spaces for multi-family residential developments. The proposed ratio of one covered space per one residential unit was criticized for potentially increasing the cost of housing, and was later changed to one covered space for every two residential units. Public parking lots owned by the City should be less contentious than residential parking and offer a starting point for testing out shade installations. The City might also consider incentive structures to encourage private, commercial property owners or multi-family developers to provide shaded parking beyond minimum requirements.

3.4 Energy

Shifting to clean, renewable, alternative sources of energy is associated with a decrease in greenhouse gas emissions which contribute to climate change. Such shifts at a large scale are necessary if cities are to meet ambitious emissions targets and attempt to mitigate rising temperatures. Energy efficiency also amounts to cost savings on household and business utility bills (US Department of Energy, 2015). While this is an excellent perk for city managers and businesses, it can be lifesaving for residents who cannot afford to run an air conditioner but are unable to cool their homes through other means. Additionally, greater energy efficiency and the availability of multiple energy sources means that power grids are less susceptible to failure during extreme heat events when demand is high, a problem that has occurred across the US with growing frequency (Stone et al., 2021). For municipal and large private or commercial structures, the following options may be considered:

- Weatherize, electrify, and update insulation in existing structures, and ensure that new buildings meet efficiency standards and incorporate passive cooling measures (through building code incentives and recommended standards that Sedona may identify, per section 3.1). These changes can be sought through incentive programs rather than government mandates. Coupling efficiency upgrades with pre-planned building renovations can be an effective access point for older buildings. Passive cooling principles to consider include building orientation and building materials that reduce heat exposure and retention; proper insulation and shading; and the use of natural ventilation when possible (United Nations Environment Programme, 2021).
- Install geothermal energy pumps, or install solar panels atop structures that can support them. The typical weather patterns of Sedona are compatible with solar energy generation and use.
- Implement a district cooling (or joint heating-cooling) model (Inayat & Raza, 2019). This system involves the delivery of chilled water to multiple buildings from one centralized location. It is more efficient and environmentally friendly than cooling individual rooms or structures through separate air conditioning systems, and is appropriate for clusters of large buildings, as one would find in a city center. Notably, district cooling is easier to implement in new development areas where several structures are being built around the same time.

At work, home, school, or in cooling centers, access to air conditioning in a heat emergency is an essential adaptation, especially for heat-sensitive populations. Some residents cannot afford the energy burden of running an air conditioner, and therefore lack access to this basic cooling resource even as people are increasingly turning to air conditioners for relief. At the same time, ever growing demand strains local energy resources and can lead to blackouts with potentially devastating consequences in a heat wave (e.g., loss of cooling, loss of access to functioning medical equipment or refrigerated medication). When it comes to protecting the energy grid and ensuring that residents can cool their homes, behind-the-meter (BTM) energy systems and/or microgrids may provide an answer (Marsh, 2023).

- BTM energy systems can be implemented widely through building-specific solar projects. The City of Sedona and non-profit partners may work with homeowners across the region to increase the uptake of solar panels, resulting in energy storage and a residential backup in the event of failure in the main power grid.
- Microgrids are shared energy systems that potentially support the use of alternative energy (solar, geothermal), promote energy independence for underserved communities, and offer a safety net in a heat emergency (Gastelum, 2022). Typically, sustainable energy sources charge batteries

for use in a blackout and may also power homes or businesses within the microgrid on a regular basis. Microgrids may take a variety of forms depending on local conditions, needs, and access to technical and financial resources. Recent case study examples that may provide some inspiration include Brooklyn, NY and Humboldt, CA (Goodwin, 2019), Boston, MA (Gastelum, 2022; Gellerman & Greene, 2021), and Borrego Springs, CA (San Diego Gas & Electric, 2024). Types of microgrids that could be appropriate for Sedona include (Think Microgrid, 2024):

  - Campus: serves buildings on a single, large piece of land such as college or medical campuses
  - Community: serves critical facilities, homes, businesses, and/or other community buildings

- While the two listed can be set up BTM, a third type of microgrid, "grid-connected," does interact with a city's main power grid and utility. A grid-connected system is not recommended if the City anticipates significant pushback or legal challenges from local power suppliers.

Consideration:

The implementation of microgrids or individual BTM energy systems, including subsidies for low-income residents to access alternative energy infrastructure (e.g., solar panels), would require significant upfront investment by the City or other funding partner.

Case Study:

MULTIPLE CASE STUDIES RESOURCE

A report released by the California Energy Commission (2018) provides detailed information about nine (9) microgrid projects in the State of California, 10 from elsewhere in North America, and seven (7) from international locations, including characteristics, costs, value-adds, and lessons learned from each. This resource offers a wealth of information from case studies in diverse climates and socio-political environments. Common motivations for implementation of a microgrid system included a desire to integrate renewable energy with conventional utilities; reduce energy bills; reduce carbon footprint; and increase resiliency, particularly when the electrical grid is disrupted by extreme weather events.

4: Funding, Policy & Legislation

4.1 Funding

Heat-mitigating infrastructure – especially green infrastructure – requires ongoing maintenance to function effectively over the long term. Maintenance can take the form of activities like watering and pruning trees, removing debris from bioswales, or cleaning permeable pavements. Failure to plan for maintenance is a common problem which prevents GI from achieving its heat mitigating potential or providing lasting relief. The City would need to identify viable and sustainable sources of funding to cover the cost of initial implementation, as well as long term maintenance to ensure sustainability (Baietti et al., 2012). Some possible routes for securing funding are described below:

- Clear policies can dictate how the City collects fees and from whom, and clarify what kinds of funders the City may partner with.
- User service fees and voter approved taxes (e.g., levies, bonds, etc.) on city residents are a possible strategy for funding GI (and general infrastructure) maintenance as they provide a steady stream of income which can be directed to that purpose. For example, the City of Tulsa collects a Stormwater Utility Fee which helps to fund the maintenance of stormwater infrastructure (City of Tulsa, 2024). New and modified taxes and fees can be levied as major projects emerge, though such fees may receive pushback from residents if the benefits are not clearly conveyed. These may take various forms such as a stormwater treatment fee, income tax, business tax, or sales tax (Zimmerman et al., 2019). On-street parking fees could be directed towards street tree planting and maintenance. Permit or development fees imposed on new developments offer a one-time infusion of funding but are not reliable as a means of supporting ongoing maintenance (Mell, 2018).

- Non-fee based options for funding GI and other heat-mitigation projects (Zimmerman et al., 2019):
    - Federal Grants from entities including the Environmental Protection Agency (EPA), the Federal Emergency Management Agency (FEMA), Housing and Urban Development (HUD), the Department of Agriculture (USDA) including the US Forest Service, and the Department of Transportation (DOT)
    - Grants from State agencies such as the Arizona Department of Water Resources, the Water Infrastructure Finance Authority of Arizona (Water Conservation Grant Fund), and Arizona State Parks & Trails (Land and Water Conservation Fund)
    - Bonds from governments, corporations, financial institutions, or investors including revenue bonds, industrial revenue bonds, green bonds, qualified energy conservation bonds, climate bonds, social impact bonds, environmental impact bonds, and catastrophe bonds
    - Donations from philanthropic organizations, charitable trusts, or private businesses

Considerations:

Making the case for funding GI can be a challenge because its economic benefits are not immediately clear. It may help if the City can articulate, in dollars, the expected cost-savings associated with GI effects, such as flood damage mitigation and reduced health care costs (Jaluzot & Ferranti, 2019). Additionally, messaging which highlights the co-benefits of GI and other heat-mitigation infrastructure can improve public or funder receptivity (Droste et al. 2017).

Single-source funding streams are easier to manage but more prone to failure when circumstances change (e.g., when a supportive funder or political ally leaves an organization). Multi-source funding streams are recommended, and may mean that the City partners with County or State entities, charitable groups, investors, and/or private businesses in addition to levying fees and use taxes (Droste et al., 2017).

4.2 Tree preservation and maintenance

Many cities have articulated policies and goals that would benefit urban trees. For example, comprehensive and climate action plans from cities like Albuquerque, NM (2017), Reno, NV (2019), and Dallas, TX (2020) set goals for tree planting, maintenance, and/or preservation. Establishing standards through plans is an effective way to articulate the problem and possible solutions, and normalize the idea of greater support for urban trees or other forms of green infrastructure. One challenge is that goals and policies are not always legally binding.

Sedona's Land Development Code, section 5.6 Landscaping, Buffering, and Screening (City of Sedona, 2024b) sets some limitations on tree removal and requirements for replacement, though the City might consider opportunities to craft new legislation in order to codify additional goals. Legislation that establishes protections, makes tree removal more difficult, and/or commits funding and staff time to the care of trees are all options to improve outcomes in the urban forest. Such protections may be especially useful in Sedona, where mature trees are stressed by rising temperatures and limited precipitation, and where new tree planting may be more cost and labor intensive than maintenance and preservation. Guidance on developing a municipal tree ordinance is available from Arbor Day Foundation here.

Case Study:

PORTLAND, OR & LOS ANGELES, CA LEGISLATION

The City of Portland, Oregon's Title 11, known colloquially as the "tree code," specifies standards for tree preservation during development. In cases when a mature tree cannot be protected from removal, developers pay a fee which goes toward planting new trees elsewhere in the city. This code also sets enforceable standards for tree density around new developments (City of Portland, 2024a). Likewise, the City of Los Angeles' "Protected Trees and Shrubs Ordinance" identifies protected trees according to size and species, and requires developers who must remove protected trees to apply for a permit and pay a fee (StreetsLA, 2024). While such requirements do not fully prevent the removal of trees, they create an additional barrier for developers and generate revenue that can be used to support other aspects of urban forestry. Legislation from these two cities offers a model for Sedona, though new ordinances will need to be carefully considered in light of the Dillon Rule.

4.3 Public health and 'right to cooling'

Heat is sometimes considered less of a priority than other environmental hazards because, except in the most extreme cases, it does not cause widespread, highly visible physical damage. However, heat kills more people in the US annually than any other environmental phenomenon, and efforts to mitigate heat have gained support as it is increasingly framed as a public health threat (Henderson et al., 2021). For example, the US Occupational Safety and Health Administration (OSHA) has released guidelines to protect workers from illness in high heat environments, and some states have laws regulating occupational heat exposure (OSHA, 2024).

Talking about and addressing heat through the lens of public health is an effective way to gain political, community, and funder buy-in. Policies and legislation which emphasize the health effects of heat may be particularly effective at improving the lives of those who are most exposed and sensitive to heat.

- Specify a heat-health policy for appropriate city departments and healthcare providers which guides outreach efforts, preparedness planning, and emergency response efforts. Such a policy would prioritize communities, localities, or socio-demographic groups which are most likely to be exposed to and/or sensitive to heat, and offer guidance on how the City and its partners can best identify and collaboratively address heat-related illness (Bolitho & Miller, 2016). Elements of this policy might favor resilience building and education, multi-pronged emergency management and response, and the development of effective heatwave alert systems (Kovats & Hajat, 2008). A policy of interdepartmental or interdisciplinary cooperation around heat should be considered, as siloed responses typically limit the effectiveness of heat-related interventions (Keith et al., 2019).
- Position the Coconino County Health Department and/or adjacent public health entities as key partners in heat mitigation and adaptation efforts moving forward. Institute a policy of City departments working closely with public health agencies on future heat vulnerability assessments, plans, responses, and education campaigns.
- 'Right to cooling' legislation and standards provide protections for tenants, outdoor laborers, and others, and makes it easier for individuals to stay cool in high-risk environments. These rules can take several forms, for example: landlords must allow rental tenants to use portable air conditioners (Oregon State Legislature, 2022), or employers must provide outdoor laborers with shade, water, and respite in certain high heat conditions (Washington State Department of Labor & Industries, 2024). It may be necessary to advocate for legislation at the statewide level due to limitations on municipal power stemming from the Dillon Rule. Local standards could be achieved through outreach, education, and incentives as described in chapter 3.1.

Case Study:

OREGON 'RIGHT TO COOLING' LEGISLATION

In spring of 2022, the Oregon legislature passed Senate Bill 1536, also known as the 'right to cooling' bill. Oregon has had a historically temperate climate, but has recently experienced an increase in extreme heat events for which residents have been largely unprepared. Some rental tenants have previously been prohibited by landlords from installing air conditioners at home, a condition challenged by tenant rights groups and public health experts. In the interest of promoting cooling access for all, the State of Oregon passed Senate Bill 1536, limiting the ability of landlords to prohibit rental-residential air conditioning use, providing air conditioner giveaways to medically-sensitive tenants, and providing rebates for heat pump installation (Oregon State Legislature, 2022).

5: Education & Engagement

5.1 Basics of outreach

Education and awareness are important components of an effective heat mitigation and adaptation strategy. On one hand, the City and its partners must convey to the public the challenges posed by heat, the importance of heat mitigation, and the economic, social, and ecological co-benefits associated with heat mitigation interventions (Wang et al., 2021b). Without such an understanding, it is less likely that residents will respond positively to cooling measures and new expenses, or that residents will take personal initiative to mitigate heat (e.g., opt to plant and maintain a tree on one's own property). On the other hand, education is a pathway to personal heat safety awareness and adaptation. Many individuals do not understand the threat posed by heat, do not imagine that they could be susceptible to heat-related illness or mortality, and do not know the signs of serious illness (Howe et al., 2019). As temperatures rise in Sedona, public health authorities and community based organizations can make a concerted effort to educate residents, commuters and tourists about the risks posed by heat – for medically sensitive as well as seemingly healthy groups – and offer advice on activities to avoid, symptoms to look for, and measures to take when exposed to high temperatures. This includes information on avoiding heat and staying safe outdoors, indoors, and over prolonged periods of exposure to high temperatures.

Engagement can inform the City's selected strategies and understanding of the problem, and cultivate community buy-in. For heat mitigation and adaptation efforts to be successful, residents must understand what the City is doing and why; must be able to connect heat-related work and challenges to their own lives, interests, and well-being; and must take some responsibility for advancing those efforts (Campbell-Arvai & Lindquist, 2021; Thorne et al., 2018). Community-based efforts can have an enormous impact on the overall heat resilience of a city, and the participation of private property owners (single family, rentals, businesses, schools) builds upon efforts made by the City. This is especially true for tree planting, given that so much urban land is privately owned and outside the purview of the City, though public buy-in also smoothes the implementation of municipal projects, new fees and taxes, and urban transformations.

5.2. Tourists

Sedona receives millions of visitors each year, many of which come for outdoor recreational opportunities. While some are from hotter areas in southern Arizona, others come from out of state and are not acclimated to Sedona's hot, dry climate. Sedona's Emergency Medical (EMS) Services team reportedly responds infrequently to heat-related calls at residences or workplaces, but regularly provides assistance to hikers. Those in need of emergency assistance are often visiting from another state, or have underlying medical conditions, and misjudge their capability on trails exposed to the elements. Warnings posted at trailheads have not proven to be an effective deterrent, and those who have come to hike will typically do so regardless of hot weather. As summertime heat and tourism both increase in Sedona, EMS could see an uptick in calls for assistance. However, reaching individuals on a trail can take time, and EMS workers feel the toll of physical exertion in the heat during rescues. For the safety of all involved, the City of Sedona might explore alternative options for engaging with tourists and conveying the risks associated with outdoor recreation in the heat.

In addition to messaging, volunteer groups, park rangers, or City staff could be deployed to distribute safety resources at trailheads on very hot days. One such group, Friends of the Forest Sedona, distributes water and information to hikers at trailheads and could serve as a model for similar programs.

Case Study:

GRAND CANYON NATIONAL PARK PREVENTION CAMPAIGN

In Grand Canyon National Park, tourists visits and annual temperatures both peak in June. Visitors frequently underestimate the difficulty of long, strenuous hikes in the heat and lack proper clothing, adequate hydration, or snacks to replenish electrolytes. When temperatures exceed 95°F, rangers see a spike in the number of emergency calls; this threshold is being crossed more often as the climate changes. Park rangers respond to an average of 300 emergency incidents each year, though this number has declined significantly since its peak in 1996, owing to a novel messaging and engagement approach. Using a system called P-SAR (preventative search and rescue), rangers and volunteers aim to prevent emergency calls by proactively giving hikers information about what lies ahead and how to stay safe. They distribute salty snacks, water, and other resources. The park has also implemented colorful, graphic warning signs showing a vomiting hiker to convey the possible consequences of hiking unprepared (Gerety, 2023).

5.3 Heat-vulnerable populations

Extreme heat is particularly dangerous to those who lack air conditioning or a cool place to seek refuge. This might include homeless individuals living outdoors in cars, tents, or without shelter; mobile home residents; low-income individuals who do not own or cannot afford to run an air conditioner; and isolated individuals who are elderly or have heat-sensitive health conditions.

Others are unable to access information, emergency alerts, and resources pertaining to heat safety, such as undocumented immigrants/refugees, individuals who do not speak English, and those who are otherwise not in touch with government services. In Sedona, the high cost of living could put low-income residents in unsafe living conditions (e.g., living on the street, living in cramped spaces without adequate cooling and ventilation). Individuals who work in the city might live elsewhere, though surrounding rural areas have far fewer resources and cool spaces.

There is a clear need for the City and partners to locate high-risk populations, understand what barriers they experience, and determine how to deploy support both proactively or during a heat emergency, though isolated or culturally-specific populations are not often accessible to local governments. The City can partner with local non-profit and/or community-based organizations that have ties to specific communities in order to build trust, gain access, and identify appropriate intervention strategies for these populations. Community-based organizations can also help distribute materials, spread emergency messages, and staff cooling centers to maximize capacity and reach.

Consideration:

Non-profit and community-based organizations offer unique access to the most heat-vulnerable populations and can expand City capacity for community engagement and action. However, these organizations often have limited funding and internal capacity. While some may be open to providing volunteer assistance, the City should seek opportunities to formally contract with non-profit and community-based organizations and compensate them for their time and labor.

6: Social Support

6.1 Financial and technical assistance

The City, non-profit groups, and other partners can support residents and businesses in taking proactive measures which allow them to adapt to heat and prepare for a hotter future. Upfront costs are a common barrier to individuals taking heat-adaptive action, and financially supportive services may encourage individuals to invest in efficient appliances, new insulation, and building weatherization. Beyond upgrades and retrofits, the daily costs of energy use may prove burdensome, especially to low-income residents. Therefore, support with home energy bills could be beneficial. Providing city resources for proper care and maintenance of trees and other vegetation may also boost public acceptance of canopy and green space expansion. Possible options for providing assistance include:

- Public subsidies or rebates for weatherization, energy upgrades, or installation of GI which offset prohibitive implementation costs (Cousins & Hill, 2021)
- Assistance with home energy bills, especially during high-heat summer months.
    - While low-income residents can apply for Arizona's Low Income Home Energy Assistance Program (LIHEAP), such programs are often difficult to access or not well known. City staff might work with non-profit partners to increase public awareness of such programs and guide their clients through the application process.
- Free tree or vegetation giveaways by the City or non-profit partners to homeowners and business owners.
- Free training for residents who wish to plant and steward trees or other GI on their properties or in their communities.
    - Training may come from a certified arborist, master gardener, GI designer, or other appropriate advisor contracted by the City.

6.2 Job training and volunteer corps

Getting Sedona residents involved in large numbers may bolster local efforts to mitigate and adapt to extreme heat (Jerome et al., 2017). Time, labor, and resources provided by residents offer a supplement to City services which may be overstretched and lacking capacity, particularly when it comes to the maintenance of new heat-mitigating infrastructure (e.g., trees and GI), checking on neighbors, or distributing cooling supplies in the community.

- Organize a volunteer corps which can serve a variety of functions with regard to heat mitigation and adaptation. For example, trained volunteers can help to deploy services and perform wellness checks during a heat emergency. Youth conservation corps are invaluable as cities expand their canopies and care for green space. Neighborhood coalitions may support ongoing maintenance of GI facilities when funding is scarce. Such groups may emerge organically, though coordination by the City, a non-profit group, or other managing entity can greatly improve their efficacy and capacity.
- Job training allows residents to get involved in the work of heat mitigation, and positions individuals for future economic gain. This approach is especially valuable in underserved communities where residents may be facing the compounded stress of low incomes and high environmental exposure (heat, air pollution, flooding). Job training, combined with the creation of more 'green

jobs' relevant to heat mitigation, is a step toward building a robust network of planners and laborers who can make heat mitigation a reality. This approach also advances environmental equity goals by connecting residents with well paid jobs and building economic resilience (Lewis & Gould, 2016).

Case Study:

TREE NEW MEXICO

Tree New Mexico (TNM) is a statewide non-profit group based in Albuquerque, which focuses solely on tree planting and tree-based education. The organization uses a mix of community planting events, free tree giveaways, and educating residents about the value of trees to get plants in the ground. Technical education is also provided to ensure long-term sustainability of newly planted trees. To this end, TNM offers training on topics such as tree and site selection, tree planting and care, proper tree pruning, trees and beneficial insects, and identifying and addressing tree problems. Education is supported by state and local experts in urban forestry and arborists, and TNM has been growing the state's urban forest for over 30 years (Tree New Mexico, 2024)

Case Study:

VOLUNTEER HEAT RESPONSE IN PHOENIX, AZ & PORTLAND, OR

The City of Phoenix operates a 'Heat Relief Network' that utilizes volunteer assistance to provide information, relief, and wellness checks. The network is a partnership of the Maricopa Association of Governments (MAG), municipalities, nonprofit organizations, the faith-based community, and businesses. Partners can list their property as a hydration/water donation station and/or a cool refuge to aid vulnerable populations (Maricopa Association of Governments, 2024b). Other volunteer roles are open to the general public. 'We're Cool' volunteers engage with Phoenix residents and visitors, especially in the downtown area, to "provide maps to cooling and hydration stations, offer health-related summer safety information, and promote enjoyable and safe activities in Phoenix during the summer months" while 'Cool Caller' volunteers provide phone-based wellness checks to high-risk households (Volunteer PHX, 2024a,b).

The City of Portland Bureau of Emergency Management, in partnership with Portland Fire & Rescue, operates a Neighborhood Emergency Teams (NET) program (City of Portland, 2024b). Although the program was originally designed for earthquake emergencies, NETs have been increasingly deployed during heat emergencies. NET volunteers provide rides to cooling shelters, pass out water and snacks to unhoused residents, and direct people toward resources. Some see a future opportunity to deploy NETs for home wellness checks to neighbors in need, though that system is not currently in place (Garcia, 2022).

6.3 Emergency response plan

Working proactively toward heat adaptation and mitigation, addressing potential problems 'upstream,' is critical to building long-term resilience. However, even in the most prepared cities, extreme heat events and emergencies do occur. The City government can be ready with a robust heat emergency response protocol which directs resources and attention to high-risk areas and communities. Components of an emergency operations plan might include:

- Open public cooling centers during daytime hours (i.e., during peak afternoon heat). City or County staff, as well as contracted non-profit partners, may be mobilized to provide staffing for government-run cooling centers.
- Offer free rides or transit fare to help vulnerable or mobility-challenged residents access cool spaces such as cooling centers, libraries, medical facilities, or public parks.
- Extend hours for air conditioned public spaces such as libraries and malls.
- Provide citywide emergency alerts in multiple languages and formats (by email, text message, phone call, on local news, online) when a heat wave is expected.
- Activate wellness checks and resources to high-risk areas such as homeless camps, mobile home parks, and affordable housing facilities. If allowable, City or County staff from agencies like homeless services, public health, emergency management, or the fire department could deploy to distribute bottled water, set up mobile cooling/misting stations, and check on city residents who appear unsafe outdoors. In-home wellness checks can be performed via phone calls to member listservs from low-income health plans, veterans and disability services, or other social programs.

Case Study:

NEW HAMPSHIRE HEAT EMERGENCY RESPONSE PLAN

Tree New Mexico (TNM) is a statewide non-profit group based in Albuquerque, which focuses solely on tree planting and tree-based education. The organization uses a mix of community planting events, free tree giveaways, and educating residents about the value of trees to get plants in the ground. Technical education is also provided to ensure long-term sustainability of newly planted trees. To this end, TNM offers training on topics such as tree and site selection, tree planting and care, proper tree pruning, trees and beneficial insects, and identifying and addressing tree problems. Education is supported by state and local experts in urban forestry and arborists, and TNM has been growing the state's urban forest for over 30 years (Tree New Mexico, 2024)

Given the potential for extreme heat and hazardous air pollution from wildfires to co-occur in Sedona, the City can consider emergency response options that address both hazards. One such strategy is to use public school buildings as summertime community refuges that provide air filtration and cooling during emergencies. This idea is relatively novel but is growing in popularity as new applications are explored nationwide (EPA, 2024c).

6.4 Resource giveaways

Distributing simple resources can make a significant impact on Sedona residents' heat health and safety at a relatively low cost. For those who work or recreate outdoors, cooling kits including ice packs, cooling towels, sun hats, or handheld fans can provide short-term relief. In-home solutions such as blackout curtains, do-it-yourself insulation supplies (sealing tape, under-door draft stoppers), and window or portable air conditioning units can improve indoor environmental conditions. Air purifiers may help those who suffer from the combined effects of heat and air pollution, and encourage residents to open windows at night to let cooler air circulate indoors (assuming poor air quality is a cause for keeping windows closed).

Case Study:

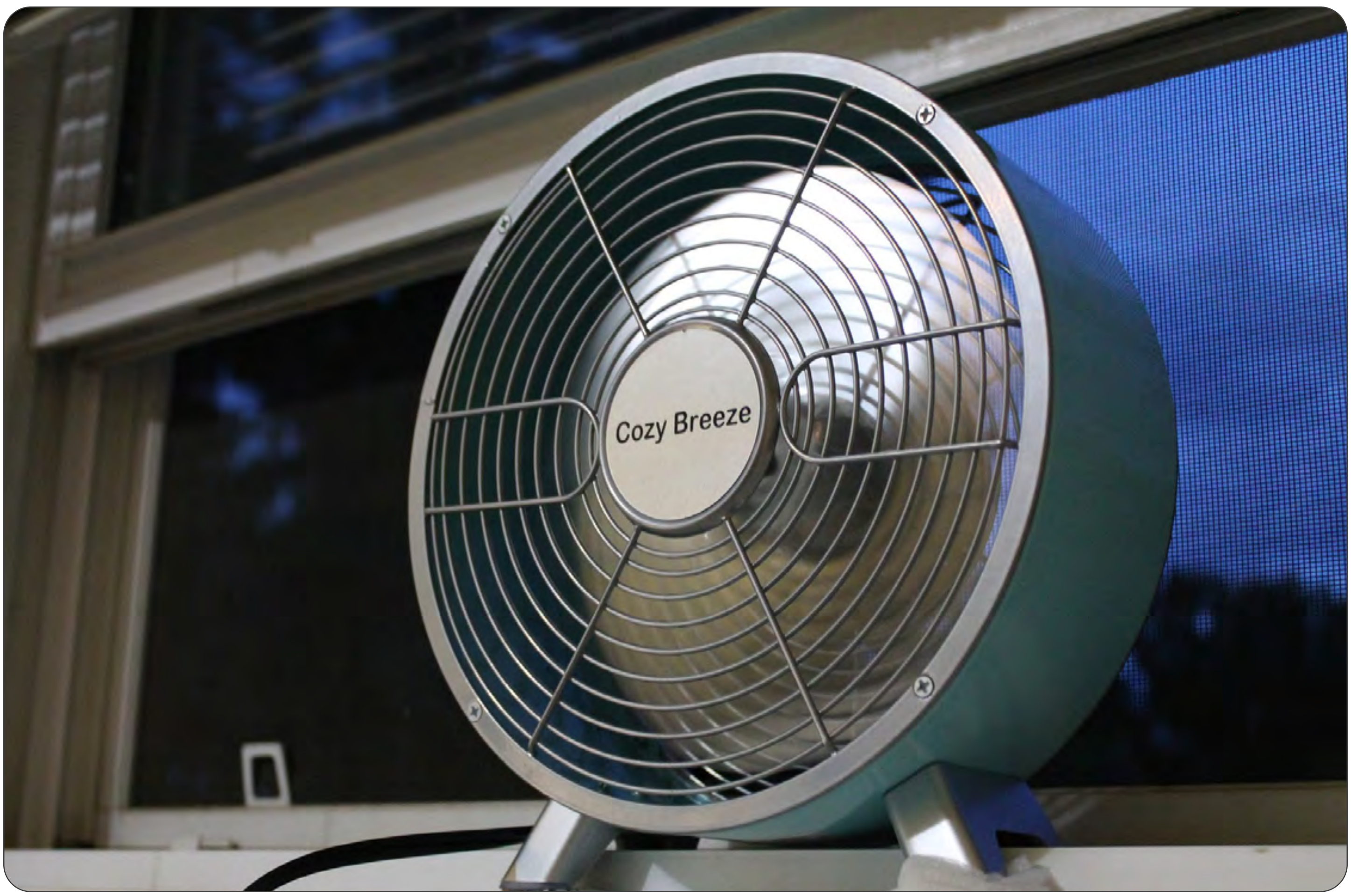
SCHOOLS AS COMMUNITY CLEANER AIR AND COOLING CENTERS

The US Environmental Protection Agency (EPA) recognizes the dual threat posed by extreme heat and poor air quality, both of which are becoming more severe as the climate changes, and both of which disproportionately affect vulnerable populations. A new grant program, funded by the American Rescue Plan, is funding four jurisdictions to develop 'cleaner air and cooling centers' within public school facilities. This includes projects in California, Oregon, Arizona, and Washington meant to transform schools into community resilience hubs where high-risk community members can seek refuge from heat and polluted air. Projects will improve indoor environmental conditions for children who attend the schools, while establishing safe spaces for others in the neighborhood. These projects target low-income, underserved areas, which typically feature higher rates of heat and air pollution, and are being done with the collaboration of community-based organizations (EPA, 2024c).

The City of Tucson also operates cooling centers throughout the summer, located within existing activity, recreation, and community centers. As of 2023, the cooling centers were open seven days a week from noon to 4 p.m. (the hottest time of day outdoors) with the exception of national holidays (City of Tucson, 2023). Prior to 2023, the City and Pima County had opened cooling centers only during extreme heat events over 110°F (Arizona Daily Star, 2022). Extended operations started in 2023 reflect the City's desire to "protect [the] most vulnerable residents as temperatures begin to rise" (City of Tucson, 2023).

7: Household & Personal Adaptations

This section is dedicated to adaptive actions that individuals can take to keep themselves safe and comfortable, and their homes cool. Individuals can apply many of the City Scale heat mitigation strategies described in the previous chapters at a personalized scale. For example, homeowners can plant trees and gardens around their properties, weatherize their homes, or install their own shade structures, solar panels or green roofs. Non-homeowners can take part in public tree planting events, start or support a community garden, or volunteer to steward trees and other green infrastructure assets in their neighborhoods. The accumulation of personal actions like these can have a real impact on outdoor urban temperatures beyond a single residence. Residents can also access household-specific solutions including airflow maximization, air conditioning and dehumidification, insulation and venting, indoor shading, and self cooling which will improve personal comfort on hot days.



7.1 Airflow maximization: strategic use of fans and windows

Maximizing airflow is one of the most effective ways to keep your home cool and does not require the use of energy-intensive air conditioners. It can often be achieved passively by opening windows and doors when there is a breeze or wind outside. During the hottest part of the day, it is better to open windows near shaded spots with cooler outdoor air, and avoid opening windows that receive high sun exposure (US Department of Energy, 2001). You can enhance airflow by adding fans in combination with open windows or air conditioning.

- Open windows overnight and in the early morning hours when air is coolest. You can also set up fans at your windows, pointing inwards, during these times. This will allow the fans to pull cool air from outside and circulate it in your home.
- Close windows during the day and early evening when outdoor temperatures are highest. This will trap cool air inside and prevent warm air from entering. Avoid using window fans to blow air into your home when outdoor temperatures are higher than indoor temperatures.
- Once outdoor temperatures cool down, you can create cross ventilation to pull cool air in and push hot air out. Do this by placing a window fan at one side of your house, pointing inwards – this fan will pull in cooler air from outside. At the same time, set up a second fan at the other side of your house, pointing outwards – this fan will remove hot air that is already in your home (US Department of Energy, 2001).
- Ceiling fans are highly effective at cooling indoor spaces, especially when combined with air conditioning. Ceiling fans should be run counterclockwise in the summer to prevent warm air being pushed down. If running a ceiling fan in combination with an air conditioner, you can set the thermostat around 4 degrees higher without experiencing a decrease in comfort (US Department of Energy, 2024b).
- Whole-house fans are costlier to install than ceiling or portable fans, but can efficiently remove hot air from your home. Like all fans, cooling potential will be limited on very hot days (i.e., over 100°F). Other options to promote targeted hot air removal and dehumidification include exhaust fans in the kitchen and bathroom (US Department of Energy, 2001).

7.2 Air conditioning

Electrical air conditioners (AC) are the most commonly-used cooling strategy worldwide, but are not a sustainable solution to extreme heat. While cooling indoor environments, they actually contribute heat to the outdoor environment, and widespread use of AC can overload local power grids resulting in blackouts. However, in the short term, air conditioners are a critical tool. They improve indoor thermal comfort and safety by reducing air temperature and humidity (Jay et al., 2021). It is recommended that residents have at least one cool room in their home which remains under 80°F (Jay et al., 2021; Oregon State Legislature, 2022). Heat pumps are an alternative to conventional ACs which are more sustainable and energy efficient, and are growing in popularity. Heat pumps, which come in both centralized and portable forms, should be prioritized over conventional AC when possible.

For residents with a portable, mechanical cooling system: In the absence of a central AC or heat pump, cooling can be achieved by using a portable or window AC unit. Close doors and other windows in the room with the portable unit to keep cold air inside, and ensure that the AC unit or exhaust pipe fits snugly in your window to prevent the loss of cooled air.

For residents without a mechanical cooling system: Air coolers incorporate a fan and cold water to circulate cool, evaporated water through the air. So-called "swamp coolers" are a do-it-yourself version and can be built by setting a blowing fan behind a tub of cold water or ice. Evaporative air coolers are not recommended for use in humid climates because they add moisture to the air, but are suitable for a semi-arid environment like Sedona's (Sustainable Energy for All, 2024).

7.3 Insulation and venting

A well-insulated house is more able to keep cool air in and hot air out when you use the cooling strategies described above (windows, fans, air conditioning). Permanent upgrades to your home can be expensive initially, but save you money in the long run by reducing your energy use for both cooling and heating. For income-qualifying households (renters and homeowners), funding is available through the State's Weatherization Assistance Program or the City's Home Energy Retrofit Project for weatherization.

Options for improving insulation:

- Install new insulation in your attic and/or under your roof. The roof is an entry point for a lot of solar radiation and heat into your home.
- Install new insulation in walls, particularly those which receive the most sun exposure during the day.
- Replace windows and doors to ensure a snug fit and reduce draftiness.

The effects of good insulation are magnified by good ventilation. This can be achieved through some actions already described, including the use of open windows and doors, exhaust fans, window fans, and central air conditioning. The idea with all ventilation is to keep air moving through your home and prevent hot air from becoming trapped inside.

- Installing a ventilation system in your attic or under-roof crawl space can help to keep hot air from entering your living space. However, it is better to prevent hot air from entering through the roof in the first place, which can be achieved with proper insulation, a reflective roof, or a green roof.

- Whole-house fan systems are a type of in-built, mechanical ventilation which are highly effective and energy efficient, and may alleviate the need to use electrical air conditioners for much of the summer (US Department of Energy, 2001; Zhang et al., 2021).

7.4 Shades, overhangs, and window films

Preventing solar radiation from hitting your home is a simple way to reduce indoor temperatures. This can be achieved by increasing the amount of shading on your property, whether through trees, tall shrubs, or manmade shade structures such as awnings, eaves, cantilevers, and similar overhangs. Installing overhangs or other shade structures around your home will keep your indoor space cooler, and provide cooler outdoor air that you can ventilate inside as needed (see *section 6.1*). Overhangs and shading on the south side of your building will have the greatest potential impact as this is the side that typically receives the most sun exposure. Detached shade structures will not cool your home but can make it more pleasant to spend time outdoors in the heat.

You can keep indoor spaces cool by having blinds down and curtains closed; this is especially important when your windows are receiving direct sunlight, such as east facing windows in the morning and west facing windows at sunset. South and southwest facing windows should be covered throughout the day (Jay et al., 2021). Blackout curtains are particularly effective at reducing indoor temperatures as they allow little to no sunlight to pass through. Thinner fabrics and slatted blinds are less effective for this purpose. Heat resistant window films are an affordable option that can be installed by residents, though these are not as easily removed as curtains and blinds when not in use.

7.5 Self cooling and rest

If you are unable to effectively cool your home or workplace, or if you are outdoors in the heat for extended periods of time, you are potentially vulnerable to heat-related stress and illness. Children under five years old, adults over 65, pregnant women, and those with certain chronic health conditions are at highest risk for illness, but even seemingly healthy adults can be susceptible. Outdoor laborers and athletes are vulnerable to heat stroke and stress resulting from sustained exertion in outdoor heat (CDC, 2024b). It is important to limit physical activity and exertion in the heat (indoor and outdoor) when possible, and rest when you feel overheated. Below are several strategies for self cooling to improve your comfort and bring down your internal body temperature.

- Drink cold water to stay cool. Drink water, tea, or other beverages at any temperature to stay hydrated during periods of heavy sweating. If engaged in prolonged or strenuous outdoor activity such as hiking, avoid overhydration by periodically eating something with salt; this will replenish your electrolytes.
- Take a cold bath or shower, or immerse your feet in cold water.
- Find a cool place to swim or play in water (e.g., a natural body of water, swimming pool, or waterpark).
- Splash water on your skin and dry in front of a fan.
- Place wet towels in the freezer and drape them over your head or body once chilled.
- Hold ice cubes or a chilled glass against pulse points on your wrists and throat, or on the back of your neck.
- Find shade or an air conditioned indoor space.

- Protect your skin from direct sun exposure with a hat, sunglasses, lightweight clothing that covers arms and legs, and/or sunblock. Light colored clothing absorbs less heat than darker fabrics. Ideally, this protection will occur before you become overheated.

Note: If you are experiencing symptoms of heat stroke, please seek medical attention. See the first linked resource in section *7.6 Resources: heat related illness and safety*, titled "Signs and Symptoms of Heat Related Illness" for more information about heat stroke symptoms.

7.6 Resources: heat related illness and safety

- Signs and Symptoms of Heat Related Illness (poster)
  https://www.cdc.gov/disasters/extremeheat/warning.html
- Avoid, Spot, Treat: Heat Stroke & Heat (infographic)
  https://www.cdc.gov/cpr/infographics/ast-heat.htm
- Heat-Related Illness and First Aid:
  https://www.cdc.gov/niosh/topics/heatstress/heatrelillness.html
- General Overview: Heat Vulnerability and Illness (includes information on humidity)
  https://my.clevelandclinic.org/health/diseases/16425-heat-illness
- Occupational Safety: Working in Indoor and Outdoor Heat Environments
  https://www.osha.gov/heat-exposure
- Protecting Disproportionately Affected Populations from Extreme Heat
  https://www.cdc.gov/disasters/extremeheat/specificgroups.html

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