M E M O R A N D U M

TO:	Rep. Kathy Castor, Chair U.S. House Select Committee on the Climate Crisis
FROM:	Renee Seacor and Catherine Pratt
CC:	Prof. Greg Dotson, University of Oregon, School of Law
DATE:	November 15, 2019
RE:	Urban Forestry in the United States and Policy Recommendations for Increasing Tree Growth in Urban Areas

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Urban areas within the United States are home to 80% of the population.[1] As of 2010, urban land totaled around 68 million acres, and previous growth trends predict that another 95.5 million acres to 163.1 million acres will become urban land by 2060.[2] This increase of urban land is of concern because the vast majority of U.S. cities have seen rapidly decreasing tree canopies and currently have alarmingly low levels of tree canopy coverage.[3] The results from the deforestation of urban areas cause widespread environmental and public health issues that are of critical concern.

This paper analyzes urban forestry programs in the U.S. and the ways that these programs can be supplemented or adjusted in order to increase overall tree growth in urban areas. First, we synthesize the existing best available science and research on the major environmental and public health benefits of urban forests. Second, we will address the economics of urban forests. The information of this section is generalized due to the varying nature of the ecosystems in the United States—cities in forest-type ecosystems average 34.4% tree cover while cities in desert ecosystems only average 9.3% coverage."[4] Fourth, we analyze the urban forestry programs in two major cities, Atlanta and New York City. We will address the strengths and weaknesses of the cities' programs. Next, we overview some non-federal programs. Then, we outline the current federal programs that created the U.S. Urban Community Forestry Program and the Land and Water Conservation Fund. Lastly, we provide policy recommendations and observations on increasing urban forests in cities across the U.S.

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[1] *Urban Forests*, CLIMATE CHANGE RESPONSE FRAMEWORK https://forestadaptation.org/focus/urban-forests
[2] David J. Nowak & Eric J. Greenfield, *US Urban Forest Statistics, Values, and Projections*, 166 J. FORESTRY 164, 165, 168 (2018).
[3] *See* Table S1 in Electronic Supplementary Material 4 *in* Robert McDonald et al., *The Value of US Urban Tree Cover for Reducing Heat-Related Health Impacts and Electricity Consumption*, ECOSYSTEMS 1 (May 06 2019). https://link.springer.com/article/10.1007%2Fs10021-019-00395-5
[4] David J. Nowak et al., *Air Pollution Removal by Urban Trees and Shrubs in the United States*, 4 URB. FORESTRY & URB. GREENING 115, 121 (2006).

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I. Environmental and Public Health Benefits of Urban Forests

When trees are removed from urban areas, human health and the environment are jeopardized by increased air pollution, soaring heat levels, and stormwater issues.[5] Additionally, areas that historically have low tree canopy coverage are also the areas with lower socioeconomic status, which raises environmental justice issues. Lastly, climate change mitigation efforts, such as carbon sequestration, are diminished when cities remove their urban forests.[6]

Though these widespread environmental and public health impacts are felt across the country, it is possible to mitigate these damages by increasing the number of trees in U.S. urban forests. Urban forests provide millions of dollars' worth of ecosystem services to the communities they exist in, and these benefits can be further increased by increasing urban forest size and health.[7] This section of the paper will outline some of the major environmental and public health benefits of urban forests including (1) carbon sequestration, (2) air pollution control, (3) heat absorption, (4) stormwater management, and (5) revitalization of communities subjected to environmental injustice.

A. Carbon Sequestration

Urban and community forests serve a critical role in the carbon cycle by serving as a carbon sink by sequestering atmospheric carbon into the soil and into trees' biomass.[8] This is an extremely invaluable tool in mitigating the effects of global climate change because the trees can offset current emission of carbon and can reduce the overabundance of carbon that will remain in the atmosphere when new emissions cease.[9] It is estimated that the entirety of the United States' urban forests could store between 350–750 million tons of carbon and that they can sequester 22.8 million tons of carbon annually.[10] However, the storage capacity and sequestration rate can vary greatly depending on the city or geographic area in question.[11] One study focused on the

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[5] Greg McPherson et al., *Municipal Forest Benefits and Costs in Five US Cities*, 103 J. FORESTRY 411, 412 (Dec. 2005) [hereinafter McPherson et al., *Municipal Forest Benefits*].
[6] *See* ECOLOGY, PLANNING, AND MANAGEMENT OF URBAN FORESTS: INTERNATIONAL PERSPECTIVES 12 (Margaret M. Carreiro et al. eds.) 12 (2008) [hereinafter ECOLOGY, PLANNING, AND MANAGEMENT].
[7] *See, e.g.*, DAVID J. NOWAK, ET AL., ASSESSING URBAN FOREST EFFECTS AND VALUES, (Feb. 2007); DON PHILLIPS, ET AL., ASSESSMENT OF ECOSYSTEM SERVICES PROVIDED BY URBAN TREES: PUBLIC LANDS WITHIN THE URBAN GROWTH BOUNDARY OF CORVALLIS, OREGON (Nov. 2011); E. Gregory McPherson et al., *The Structure, Function and Value of Urban Forests in California Communities*, 28 URB. FORESTRY & URB. GREENING 43 (2017) [hereinafter McPherson et al., *California Communities*].
[8] Daolan Zhenga et al., *Assessing Net Carbon Sequestration on Urban and Community Forests of Northern New England, USA*, 12 URB. FORESTRY & URB. GREENING 61, 61 (2013); David J. Nowak & Daniel E. Crane, *Carbon Storage and Sequestration by Urban Trees in the USA*, 116 ENVT'L POLLUTION 381, 381 (2001).
[9] Nowak & Crane, *supra* note 8, at 381.
[10] Nowak & Crane, *supra* note 8, at 382, 387.
[11] Nowak & Crane, *supra* note 8, at 386.

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value of carbon sequestration by trees and aimed to estimate net forest carbon sequestration in urban and community lands in northern New England. The study estimated that the region's urban and community forests sequestered 603,200 tons of carbon per year.[12] This was valued at $38.7 million a year and contributed 8.2% of the New England region's net forest ecosystem carbon sequestration.[13]

This opportunity to sequester carbon in urban trees is crucial to efforts to address climate change. The latest Intergovernmental Panel on Climate Change (IPCC) report stated that in order to limit the warming of the plant to 1.5℃ by 2050, forests must be increased by one billion hectares (ha).[14] After this report was published, researchers sought to determine if it was possible to achieve one billion ha in global forest growth.[15] Studies discovered that, outside of existing forests, agricultural land, and urban land, there was the potential to increase forest cover by 0.9 billion ha, which would store 205 gigatons of carbon.[16] Scientists also stated that photosynthetic carbon capture by global tree restoration was likely one of the most effective climate change solutions we have to date.[17] In addition to the 0.9 billion ha of potential tree coverage, an additional 0.1 billion ha will be needed to reach the IPCC's one billion ha target.[18] This additional 0.1 will have to take place in urban and agricultural lands not accounted for in this study.[19] Therefore, the necessity of urban forest growth to mitigate the effects of global climate change cannot be overstated.

B. Air Pollution Control

Urban areas are disproportionately impacted by poor air quality,[20] with minorities bearing the brunt of the impact.[21] To combat air pollution emissions and pollutant concentrations, the EPA has set National Ambient Air Quality Standards (NAAQSs) for criteria air pollutants, such as particulate matter (PM_x), ozone, sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and carbon monoxide (CO).[22] Despite these efforts, air pollution is still a major problem and continues to be a leading cause or morbidity and mortality. For example, particulate matter less than 2.5µm

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[12] Zhenga et al., *supra* note 8 at 66.
[13] Zhenga et al., *supra* note 8, at 61.
[14] Intergovernmental Panel on Climate Change (IPCC), An IPCC Special Report on the Impacts of Global Warming of 1.5 °C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways (2018).
[15] Baston, Jean-Francois et al., *The Global Tree Restoration Potential*, 365 SCIENCE. 76, 76 (5 July 2019).
[16] *Id.* at 78.
[17] *Id.* at 76
[18] *Id.*
[19] *Id.*
[20] *See* Heather Strosnider et al., *Rural and Urban Differences in Air Quality, 2008–2012, and Community Drinking Water Quality, 2010–2015—United States*, 66 SURVEILLANCE SUMMARIES 1 (2013).
[21] THE WORLD BANK, THE COST OF AIR POLLUTION STRENGTHENING THE ECONOMIC CASE FOR ACTION 2 (2016). *See* Juan C. Celedón et al., *Respiratory Health Equality in the United States: The American Thoracic Society Perspective*, 11 ANNALS ATS 473, 474 (2014).
[22] *See generally*, *Criteria Air Pollutants*, EPA https://www.epa.gov/criteria-air-pollutants (last visited Nov. 1, 2019).

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($PM_{2.5}$) and ozone are the pollutants have the highest mortality rates, causing between 130,000 and 360,000 premature deaths in the United States annually.[23] The societal costs of the $PM_{2.5}$-related deaths in 2011 alone were estimated at $886 billion.[24]

Fortunately, urban forests not only remove carbon from the air, but also other pollutants that are harmful to human health. On average, urban trees remove 822,000 tons of air pollution per year in the U.S.[25] The value of the pollution removal is estimated at $3.8 billion, and includes removal of ozone, SO_2, NO_2, and PM_x.[26] One study calculated the air quality benefits from the Million Trees campaign in Los Angeles.[27] The campaign resulted in reduction of "3,100 tons of ozone, 2,500 tons of nitrogen dioxide, 400 tons sulfur dioxide, 2,400 tons of small particulate matter, and 500 tons of volatile organic compounds," and the resulting ecosystem services were valued at $68 million.[28] Because trees can remove these pollutants from the air, states should try to include urban forests in their State Implementation Plans (SIPs). The EPA has allowed tree planting to count towards certain SIP credits because of how effective they are at removing pollutants—especially ozone and PM_x.[29] This fact can be especially appealing considering that planting trees is a proven cost-effective way to reduce urban air pollutants.[30]

Though there is research which strongly indicates that urban forests can help purify the air and reduce ozone levels, trees can be an emitter of biogenic volatile organic compounds (VOCs).[31] Because biogenic VOCs can result in ozone,[32] additional trees may cancel out some of the ozone decreases from reduced Urban Heat Island effect.[33] That being said, biogenic VOC emissions depend on weather conditions and the type of vegetation,[34] and the increase in biogenic VOCs is negligible in some areas that have poor air quality.[35] Additionally, having a tree canopy is still better than having no tree canopy or a reduced one as suggested by a

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[23] Fabio Caiazzo et al., *Air Pollution and Early Deaths in the United States. Part I: Quantifying the Impact of Major Sectors in 2005*, 79 ATMOSPHERIC ENVT. 198, 198 (2013).
[24] Andrew L. Goodkind et al., *Fine-Scale Damage Estimates of Particulate Matter Air Pollution Reveal Opportunities for Location-Specific*, 116 PNAS 8775, 8777 (2019).
[25] Nowak & Greenfield, *supra* note 2, at 174.
[26] Nowak et al., *supra* note 4, at 121.
[27] *How Trees Improve Air Quality*, Vibrant Cities Lab https://www.vibrantcitieslab.com/resources/how-trees-improve-air-quality/
[28] *Id.*
[29] Pacific Southwest Research Station, USDA Forest Service, *Air Pollution Control—The Tree Factor*, URB. FOREST RES. 6 (2005); Nowak et al., *supra* note 4, at 122.
[30] ROBERT MCDONALD ET AL., THE NATURE CONSERVANCY, PLANTING HEALTHY AIR: A GLOBAL ANALYSIS OF THE ROLE OF URBAN TREES IN ADDRESSING PARTICULATE MATTER POLLUTION AND EXTREME HEAT 5–7 (2016).
[31] EPA, REDUCING URBAN HEAT ISLANDS: COMPENDIUM OF STRATEGIES, TREES AND VEGETATION 9 (2008) [hereinafter EPA, TREES AND VEGETATION].
[32] DAVID J. NOWAK, THE EFFECTS OF URBAN TREES ON AIR QUALITY, USDA Forest Service 2 (2002).
[33] EPA, TREES AND VEGETATION, *supra* note 31, at 9.
[34] EPA, TREES AND VEGETATION, *supra* note 31, at 9–10.
[35] *See* Christopher J. Luley & Jerry Bond, *A Report to North East State Foresters Association: A Plan to Integrate Management of Urban Trees into Air Quality Planning*, DAVEY RESOURCE GROUP (Mar. 2002).

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simulation where a 20% reduction in Atlanta's urban forest resulted in a 14% increase in ozone concentrations due to the resulting increase in the urban heat island effect.[36] Thus, urban forests, despite their potential to increase ozone emissions, are better than deforestation of the urban forest, and biogenic VOC mitigation can be achieved by partnering with the U.S. Forest Service (USFS) in order to receive guidance on which trees to select in order to reduce biogenic VOC production from urban forests.[37]

C. Heat Absorption

Surface and atmospheric temperatures are influenced at the micro level by the type of land use activities in a given area.[38] This is cause for concern due to the increased size of urban areas within the United States. Urban areas are impacted by a phenomenon called the "heat island effect" or the "urban heat island" (UHI) effect, where urban areas are warmer than the rural areas surrounding or adjacent to them.[39] The UHI effect has massive impacts on both human health and energy consumption.[40] Fortunately, research shows that increasing urban tree canopy can combat the impacts of the UHI effect.[41]

There are two types of heat island effects—surface heat island and atmospheric heat islands. Surface heat islands are caused by impermeable surfaces, such as roofs and pavement, that absorb heat from the sun, which can be upwards of 50 to 90°F hotter than the surrounding air temperature.[42] Because this type of UHI effect is directly related to the intensity of the sun, the impacts are greatest during the day and summer season, and this effect can increase daytime air temperatures by 18 to 27°F relative to rural areas.[43] Conversely, atmospheric UHI effect is related to the release of heat from urban infrastructure.[44] Its impacts are most intense from sunset to dawn and during the winter, and it can increase nighttime air temperatures by 12.6 to 21.6°F relative to rural areas.[45] A study of sixty cities in the U.S. found that in the past decade, cities were on average 2.4°F hotter than their adjacent rural areas during the day and 4°F warmer at night.[46]

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[36] NOWAK, *supra* note 32, at 3.
[37] *See e.g.* David J. Nowak, et al., *Estimated Biogenic VOC Emission Rates for Common U.S. Trees and Shrubs*, U.S.D.A., Forest Service, NE Research Station (2002) https://www.nrs.fs.fed.us/units/urban/local-resources/downloads/vocrates.pdf.
[38] EPA, REDUCING URBAN HEAT ISLANDS: COMPENDIUM OF STRATEGIES, URBAN HEAT ISLAND BASICS 4 (2008) [hereinafter EPA, URBAN HEAT ISLAND BASICS].
[39] *Id.* at 1.
[40] *See Id.*; Heat Island Group, *Urban Heat Islands*, Berkeley Lab, https://heatisland.lbl.gov/coolscience/urban-heat-islands; McDonald et al., *supra* note 3, at 2.
[41] *See* McDonald et al., *supra* note 3, at 2; Marshall Sheapard et al., *Improving Heat-Related Health Outcomes in an Urban Environment with Science-Based Policy*, 8 SUSTAINABILITY 1015 (Oct. 2016).
[42] EPA, URBAN HEAT ISLAND BASICS, *supra* note 38, at 2.
[43] EPA, URBAN HEAT ISLAND BASICS, *supra* note 38, at 2.
[44] EPA, URBAN HEAT ISLAND BASICS, *supra* note 38, at 2.
[45] EPA, URBAN HEAT ISLAND BASICS, *supra* note 38, at 2–3.
[46] Alyson Kenward et al., *Summer in the City: Hot and Getting Hotter*, Climate Central 4, 9 (2014). http://assets.climatecentral.org/pdfs/UrbanHeatIsland.pdf.

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The most concerning impact of the UHI effect is the excessive heat in cities, which is increasing morbidity and mortality among humans living in the urban areas. High temperatures are blamed for roughly 600 to over 1300 deaths annually in the United States alone,[47] and heat is the number one weather-related cause of death.[48] The UHI effect exists every day, but its impacts are also likely to exacerbate heat wave events which will become more frequent as climate change continues to increase global temperature.[49] The impacts of the resulting higher temperatures manifest by directly increasing instances of heat exhaustion and heat stroke, as well as by indirectly exacerbating existing cardiovascular, pulmonary, and renal diseases.[50]

The excessive heat can also increase chemical reactions which result in higher level of dangerous air pollutants. For instance, UHI effects can worsen ground-level ozone levels which can harm sensitive populations.[51] The annual cost of ozone from lost time from work and medical bills is upwards of $3 billion.[52] One study found that "51 of the 52 cities [in the study] with adequate air quality data showed a statistically significant correlation between daily summer temperatures and ground level ozone concentrations."[53] This study found that when temperature and ground-level ozone were plotted on a chart, there was a positive linear association between the two.[54] Such impacts cause cities to constantly worry about their attainment of NAAQSs and the costs associated with staying in attainment.[55]

In addition to impacting human health, UHIs can dramatically increase energy consumption. "Research shows that electricity demand for cooling increases 1.5–2.0% for every 1°F (0.6°C) increase in air temperatures, starting from 68 to 77°F (20 to 25°C), suggesting that 5–10% of community-wide demand for electricity is used to compensate for the heat island effect."[56] Although air conditioning has been associated with a decrease in heat-related deaths,[57] the increased energy costs associated with using air conditioning to combat the higher

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[47] McDonald et al., *supra* note 3, at 2.
[48] National Weather Service, *Weather Related Fatality and Injury Statistics*, NOAA https://www.weather.gov/hazstat/.
[49] Dan Li & Elie Bou-Zeid, *Synergistic Interactions between Urban Heat Islands and Heat Waves: The Impact in Cities Is Larger than the Sum of Its Parts*, 52 J. APPLIED METEOROLOGY & CLIMATOLOGY 2051, 2056 (Sept. 2013); McDonald et al., *supra* note 3, at 2.
[50] McDonald et al., *supra* note 3, at 2.
[51] TIMMONS ROBERTS ET AL., SUMMARY: PRELIMINARY ASSESSMENT OF RHODE ISLAND'S VULNERABILITY TO CLIMATE CHANGE AND ITS OPTIONS FOR ADAPTATION ACTION, 19, 28 (Feb. 2010).
[52] H. Akbari, *Shade Trees Reduce Building Energy Use and CO_2 Emissions From Power Plants*, 116 ENVTL. POLLUTION S119, S121 (2002).
[53] Kenward et al., *supra* note 46, at 17.
[54] Kenward et al., *supra* note 46, at 17–18.
[55] *See generally Potential Economic Impacts of a Stricter Ozone Standard*, National Association of Manufacturers, (July 2014) https://www.nam.org/wp-content/uploads/2019/05/Ozone-Report-Executive-Summary-20140730.pdf.
[56] *Heat Island Impacts*, EPA, https://www.epa.gov/heat-islands/heat-island-impacts (last visited Nov. 10, 2019).
[57] McDonald et al., *supra* note 3, at 2.

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temperatures is increasing air pollution—including emissions of CO_2—and the financial burden on residents.[58]

Fortunately, protecting existing urban forests and increasing tree canopy cover can mitigate the UHI effect and thereby improve human health and decrease energy costs. There is a myriad of ways that trees keep cities cool— acting as a windbreaker from hot and cold winds, evaporative cooling in the summer and reduced evapotranspiration in the winter, and shading for the summer.[59] Keeping cities cool can decrease energy costs and improve health outcomes associated with hot temperatures in urban areas. In fact, one study found that current "urban tree cover annually supplies heat-reduction services worth $5.3–12.1 billion" from avoided heat-related mortality.[60]

Utilizing the wind breaking benefit of urban trees is not usually considered as a solution to the UHI effect. However, the benefits of wind blocking can improve energy saving in both the summer and winter, allowing the investment of urban forests to provide year-round benefits.[61] This is in part because a disruption in wind speed reduces the wind's ability to blow outdoor air into buildings.[62] For instance, research suggests that a well-forested park could reduce down-wind peak air temperatures by 5°C.[63]

Shading alone can account for a reduction of 2–7% of electricity costs for both heating and cooling.[64] For instance, one study found that a shaded location saved 4 kWh/day compared to an unshaded one and that air condition did not need to be used until it was 20.3°C (68.5°F) (compared to 18.7°C (65.6°F) for the unshaded location).[65] Another study focusing on Kansas City found that planting trees around every building to ensure each building has shade coverage on at least 25% of the building's outer surface could result in a "regional annual direct energy cost savings [of] $21M" and a payback period of 4.9 years.[66] In order to maximize the reduction of building cooling and heating costs through the planting of shade trees, some considerations need to be included in the planting process. Energy reduction was highest in buildings that had

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[58] EPA, URBAN HEAT ISLAND BASICS, *supra* note 38, at 14.
[59] Dania M. Abdel-Aziz, *Effects of Tree Shading on Building's Energy Consumption*, 3 J. ARCHITECTURAL ENGINEERING TECH. 1, 2 (2014); McDonald et al., *supra* note 3, at 3.
[60] McDonald et al., *supra* note 3, at 1.
[61] EPA, TREES AND VEGETATION, *supra* note 31, at 3.
[62] ECOLOGY, PLANNING, AND MANAGEMENT, *supra* note 6, at 58.
[63] McDonald et al., *supra* note 3, at 3.
[64] Abdel-Aziz, *supra* note 59, at 2.
[65] Hashem Akbari et al., *Peak Power and Cooling Energy Savings of Shade Trees*, 25 ENERGY & BUILDINGS 140, 142 (1997).
[66] The payback period was determined by assuming a price of $100/tree for planting multiplied by the calculated number of trees required for 25% shading on the west, south, and east faces of all buildings and then divided by the annual direct energy savings. Haley Gilbert et al., *Heat Island Mitigation Assessment and Policy Development for the Kansas City Region*, Lawrence Berkeley National Laboratory 5, Appendix C 4 (Aug. 2019).

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shading on the western face of the building,[67] and the eastern side was the second most important to shade.[68] Though shading the southern face of a building also provided energy benefits, research warns of the negative impacts on winter solar energy production for solar arrays placed on the southern face of the buildings.[69] Additionally, in areas that could not support tree growth—be it lack of space or poor soil conditions—research supports that planting vines on buildings can create similar, if smaller scale, shading benefits.[70]

Lastly, evapotranspiration is the process by which leaves from vegetation release water into the atmosphere.[71] Evapotranspiration results in a cooling effect in the air due to the absorption of latent heat of vaporization from the ambient air that converts liquid water into water vapor.[72] Because heat is removed when the water vapor is formed, the temperature of the ambient air cools and also experiences an increase in humidity—this is known as the oasis effect.[73] Evapotranspiration has been found to result in the following:

1. "Peak air temperatures in tree groves that are 9ºF (5ºC) cooler than over open terrain.
2. Air temperatures over irrigated agricultural fields that are 6ºF (3ºC) cooler than air over bare ground.
3. Suburban areas with mature trees that are 4 to 6ºF (2 to 3ºC) cooler than new suburbs without trees.
4. Temperatures over grass sports fields that are 2 to 4ºF (1 to 2ºC) cooler than over bordering areas."[74]

The impacts of evapotranspiration average out to a 2–9°F (1–5°C) cooling effect on the air.[75] Because the cooling effect is more noticeable with large vegetation, such as trees, than smaller vegetation, such as grass, communities should try to aim to increasing the amount of larger vegetation. If the area is not able to support a tree, then smaller vegetation—like shrubs—should be considered before covering the ground with grass.

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[67] Akbari et al., *supra* note 65, at 144. *See generally* E. GREGORY MCPHERSON & JAMES R. SIMPSON, CARBON DIOXIDE REDUCTION THROUGH URBAN FORESTRY: GUIDELINES FOR PROFESSIONAL AND VOLUNTEER TREE PLANTERS 15 (2000).
[68] MCPHERSON & SIMPSON, *supra* note 67, at 15.
[69] MCPHERSON & SIMPSON, *supra* note 67, at 15–16.
[70] EPA, TREES AND VEGETATION, *supra* note 31, at 3–4.
[71] *Evapotranspiration and the Water Cycle*, USGS, https://www.usgs.gov/special-topic/water-science-school/science/evapotranspiration-and-water-cycle?qt-science_center_objects=0#qt-science_center_objects
[72] ECOLOGY, PLANNING, AND MANAGEMENT, *supra* note 6, at 58.
[73] ECOLOGY, PLANNING, AND MANAGEMENT, *supra* note 6, at 58.
[74] EPA, TREES AND VEGETATION, *supra* note 31, at 3.
[75] *Using Trees and Vegetation to Reduce Heat Islands*, EPA https://www.epa.gov/heat-islands/using-trees-and-vegetation-reduce-heat-islands.

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D. Stormwater Management

The transformation of natural permeable landscapes into urban impervious surfaces causes stormwater runoff, which in turn causes water quality and quantity issues.[76] Local governments know firsthand the challenge of managing stormwater runoff in order to avoid potential flooding and water pollution. There has been an emerging interest among local planning departments to utilize green stormwater infrastructure for the management of stormwater.[77] Green infrastructure utilizes the potential of soil and vegetation to infiltrate, redistribute, and store excess water.[78] Trees may provide an effective way to complement stormwater management providing a broader range of benefits by routing rainfall into numerous parts of the hydrological cycle.[79]

The benefits of urban forests on stormwater management have not been as widely studied in comparison to some of the other benefits of urban forests, such as carbon sequestration and air quality. However, studies have indicated that the mere presence of tree canopy coverage over impervious surfaces can reduce runoff by as much as 40%.[80] Some of the complementary stormwater management benefits that trees can provide include canopy interception loss, transpiration, improved infiltration, and potential benefits via deeper percolation along root channels and water table management. Additionally, it can save municipalities money on stormwater management systems because the reduction in the percentage of rain that becomes runoff can reduce the volume of stormwater handled by these systems during peak runoff.[81] This in turn, can save energy and reduce CO_2 emissions from water plants that process and treat stormwater.[82]

E. Environmental Justice and Community Revitalization

The environmental justice movement aims to address the disproportionate environmental risks borne by the poor and communities of color.[83] In addition to disproportionate environmental risks, poor and minority communities commonly face inequitable access to environmental benefits such as parks and green spaces.[84] Studies have shown cities such as Los

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[76] Adam Berland et al., *The Role of Trees in Urban Stormwater Management*, 162 LANDSCAPE & URB. PLANNING 167 (June 2017).
[77] *Id.*
[78] *Id.*
[79] *Id.*
[80] DAVID J. NOWAK & JOHN F. DWYER, *Understanding the Benefits and Costs of Urban Forest Ecosystems*, *in* URBAN AND COMMUNITY FORESTRY IN THE NORTHEAST, 34 (J. E. Kuser ed., 2007).
[81] *Id.*
[82] CENTER FOR NEIGHBORHOOD TECHNOLOGY, THE VALUE OF GREEN INFRASTRUCTURE: A GUIDE TO RECOGNIZING ITS ECONOMIC, ENVIRONMENTAL AND SOCIAL BENEFITS, 11 (2010)
[83] CLIFFORD RECHTSCHAFEEN ET AL., ENVIRONMENTAL JUSTICE LAW POLICY AND REGULATIONS 3 (2nd ed. 2009).
[84] Jennifer Wolch et al., *Parks and Park Funding in Los Angeles: An Equity-Mapping Analysis*, 26 URB. GEOGRAPHY 4 (2005).

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Angeles,[85] New York,[86] and San Francisco[87] all provide inequitable access to urban green space. The distribution of green space often disproportionately benefits predominantly white and more affluent communities. Urban green space is fundamental to the livability of cities and is often tied closely to economic development of neighborhoods.[88] Accordingly, urban forests provide a rich array of benefits to environmental justice communities.[89]

Studies have shown that predominantly white areas have more access to green space as contrasted to minority communities.[90] In addition, areas with higher home ownership saw more tree coverage.[91] Therefore, the benefits that increased canopy cover provide including ecosystem services such as cooling city streets, providing energy savings, and removing air pollution are inequitably distributed across communities. As cities begin to develop urban forestry programs aimed at increasing canopy cover within their cities, they need to consider the equitable distribution of the social, environmental, and economic benefits of trees. Ensuring that the benefits of urban forests are felt equally across varying communities is essential to addressing concerns of the environmental justice movement.

The U.S. Forest Service developed an Urban Forest Research Department whose mission is to provide research to inform urban forest development that improves environmental health and community well-being in urban areas.[92] The Urban Forest Research Department aims to address the environmental inequalities of disproportionate canopy cover and access to green space, as well as the vulnerability of some groups to climate change.[93]

Studies have proven the immense public health benefits that urban forests provide to the health of residents in communities. These public health benefits include decreased stress levels,[94]

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[85] *Id.*
[86] Samara F. Swanston, *Environmental Justice and Environmental Quality Benefits: The Oldest, Most Pernicious Struggle and Hope for Burdened Communities*, 23 VT. L. REV. 545, 555–60 (1999).
[87] Paul Stanton Kibel, *The People Down The Hill: Parks Equity in San Francisco's East Bay*, 1 GOLDEN GATE U. ENVTL. L. J. 331, 332 (2007);
[88] *Id.*
[89] *Id.*
[90] Jennifer R. Wolch et al., *Urban Green Space, Public Health and Environmental Justice: The challenge of making cities 'just green enough*,' 125 LANDSCAPE & URB. PLAN. 234, 236. (2014).
[91] Joan Flocks et al. *Environmental Justice Implications of Urban Tree Cover in Miami-Dade County, Florida*, 4 ENVT L. JUST. 125, 131 (June 17, 2011).
[92] *See generally* U.S. Forest Service, *Urban Research*, DEPARTMENT OF AGRICULTURE https://www.fs.fed.us/research/urban/ (last visited Nov. 1, 2019).
[93] USDA FOREST SERVICE, ENVIRONMENTAL JUSTICE IN URBAN COMMUNITIES THROUGH URBAN FORESTS 1 (Feb. 2013).
[94] Catherine Ward Thompson et al., *More Green Space is Linked to Less Stress in Deprived Communities: Evidence from Salivary Cortisol Patterns*, 105 LANDSCAPE & URB. PLAN. 221, 226 (2012).

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lower rates of childhood asthma,[95] increased physical activity and lower rates of obesity,[96] lower ambulatory heart rate,[97] increased mental health—specifically anxiety and mood disorders,[98] decreased crime rates,[99] and increased sense of community and neighborhood cohesiveness.[100] The public health and community benefits of urban forests cannot be overstated. Urban green space provides countless benefits that increase the overall health and happiness communities across the nation.

II. The Economics of Urban Forests

As explained in the previous section, trees provide benefits in both macro and micro environments. Due to their inherent value, a compensatory cost to replace every tree in the contiguous forty-eight states that is part of an urban forest is valued at roughly $2.4 trillion, or $630 per tree.[101] The cost-benefit analysis of trees has generally concluded that trees output more benefits than cities and communities are required to input.[102]

However, studies also indicate that despite the general public's interest in having trees in public areas (trees as public goods), there is a lower interest in having trees on people's property (trees as private goods).[103] This is likely because urban forests, despite providing both quantifiable and unquantifiable benefits, carry an array of costs and risks.[104] Further, there are some issues that can arise that are not always factored into the costs of urban forests. In order to bring these things to light, this section focuses on several areas that are critical factors to consider before cities, municipalities, or other organizations start planting trees.

A. Tree Planting and Maintenance

Studies and statistics indicate that people who live in urban areas show a general enthusiasm and interest in having trees in parks and green spaces, having trees lining highway

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[95] G. S. Lovasi et al., *Children Living in Areas with More Street Trees have Lower Prevalence of Asthma*, 62 J. EPIDEMIOL COMMUNITY HEALTH 647, 648 (2008).
[96] Anne Ellaway et al., *Graffiti, Greenery, and Obesity in Adults: Secondary Analysis of European Cross-Sectional Survey*, 331 BRIT. MED. J. 611, 612 (2005).
[97] Eugenia C. South et al., *Neighborhood Blight, Stress, and Health: A Walking Trail of Urban Greening and Ambulatory Hearth Rate*, 105 AM. J. PUB. HEALTH 909, 911–12 (2015).
[98] D. Nutsford et al.. *An Ecological Study Investigating the Association Between Access to Urban Green Space and Mental Health,* 127 PUB. HEALTH 1005, 1010 (2013).
[99] Frances E. Kuo et al., *Fertile Ground for Community: Inner-City Neighborhood Common Spaces*, 26 AM. J. COMMUNITY PSYCHOL. 823, 848 (1998).
[100] *Id.*
[101] A compensatory value is the monetary value that would be due in order to offset the lost benefits when a tree is removed, but only views the tree as a structural asset. NOWAK & DWYER, *supra* note 80, at 34–36, 40.
[102] EPA, TREES AND VEGETATION, *supra* note 31, at 11.
[103] Shyamani D. Siriwardena et al., *The Implicit Value of Tree Cover in the U.S.: A meta-analysis of hedonic property value studies*, 128 ECOLOGICAL ECONOMICS 68, 75 (2016).
[104] *Id.*

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corridors, and having trees on their property and residential area.[105] But in order to meet these desires, cities and municipalities will likely be forced to take the initiative to increase their tree planting and tree maintenance efforts. This brings us to the most obvious cost of urban forests—increasing and maintaining an urban forest requires potentially large monetary and labor resource inputs.

The economic costs and benefits of urban forests are relatively site-specific due to the differing ecosystems that cities exist in. This is because "[u]rban tree cover varies by region within the United States with cities developed in forest areas averaging 34.4% tree cover, cities in grassland areas [averaging] 17.8%, and cities in deserts [averaging] 9.3%."[106] Further, the ecosystem of the locality can influence the benefits produced by the trees; a single tree in Glendale, Arizona may only produce $31 in benefits annually while a tree in Berkley, California may produce $83 in benefits.[107] This is because different trees can produce varying levels of benefits.[108] Sometimes, the benefits produced by certain trees can be overcome by the costs associated with their maintenance.[109] Further, studies suggest that an average town will spend $5.83 per person annually on urban forestry activities,[110] and a town can spend anywhere from $13 to $65 annually per tree.[111] Thus, in order to ensure that the input to output ratio of resources is maximized, careful planning and consideration needs to occur before trees are planted.

Tree planting programs are a great way to increase urban forest numbers. However, a cost-benefit analysis for planting trees needs to consider that trees grow slowly, which means that some expected benefits may not even begin to appear until five years after planting.[112] Further, during these first few years young trees need regular maintenance to ensure their survival.[113] This particular fact is especially troublesome for cities who have programs where private land owners request a tree from the city and then the private owners take on the planting and maintenance roles. A review of the results of Sacramento County's Shade Tree Program found that 15% of distributed trees did not even get planted and 46% of the planted trees died within five years.[114] When similar programs have such low tree survivorship, it dramatically

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[105] NOWAK & DWYER, *supra* note 80, at 39.
[106] Nowak et al., *supra* note 4, at 121.
[107] ALLIANCE FOR COMMUNITY TREES, BENEFITS OF TREES AND URBAN FORESTS: A RESEARCH LIST, 2 (Aug. 2011).
[108] *E.g.* Natalie S. van Doorn & E. Gregory McPherson, *Demographic Trends in Claremont California's Street Tree Population*, 29 URB. FORESTRY & URB. GREENING 200, 208 (2018).
[109] McPherson et al., *California Communities*, *supra* note 7, at 50.
[110] McDonald et al., *supra* note 3, at 11.
[111] McPherson et al., *Municipal Forest Benefits*, *supra* note 5, at 415.
[112] EPA, TREES AND VEGETATION, *supra* note 31, at 11.
[113] EPA, TREES AND VEGETATION, *supra* note 31, at 14.
[114] Lara A. Roman et al., *Determinants of Establishment Survival for Residential Trees in Sacramento County, CA*, 29 LANDSCAPE & URB. PLANNING 22, 28 (2014).

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increases sunk inputs and negatively impacts the costs to benefits ratio, turning what could have been a cost-saving program into a cost-inflating one.

Another potential cost is that special attention must be given to the compatibility of trees with the ecology of the municipal area. A tree that is poorly suited to its planted environment may need more resources than the local environment can provide. For instance, the presence of trees that uptake large volumes of water can negatively impact areas that are prone to droughts or that have arid climates.[115] Plus, the energy use needed to provide water to water-intensive trees can be twice as high as the energy savings from shading produced by the same trees.[116] This problem is also true for trees that are sensitive to air pollutants. If a city goes on a tree planting campaign with the goal to reduce air pollutants, a preliminary evaluation of the performance of trees to uptake air pollutants needs to be performed, lest trees be planted that can actually be killed by high air pollution levels.[117]

Pests and diseases are other issues that cities and municipalities need to consider. It is estimated that local governments spend $1.7 billion annually removing trees killed by insects or disease, and homeowners spend an additional $1 billion to remove and replace trees killed by pests.[118] Not only is this cost extremely high, "the cost of local tree treatment, removal, and replacement is at least ten times that of federal programs to suppress pests, or prevent their spread."[119] Because the cost of pest treatment is so high, homeowners with infected trees may not act quickly enough to contain the spread of the infestation, which can allow the total cost to eradicate the pests in a given area to skyrocket.[120] The delayed response to pests or disease by private land owners has prompted some cities to give themselves the right to remove diseased and infested trees from private property.[121] In order to prevent catastrophic loss from a single threat, cities need to incorporate many different types of tress into their urban forest plan in order to promote biodiversity.[122]

Additionally, the introduction of exotic or non-native species can permanently change the ecology of the area as these new species out compete native plants.[123] This is especially

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[115] NOWAK & DWYER, *supra* note 80, at 34.
[116] NOWAK & DWYER, *supra* note 80, at 34.
[117] *See* C. S. Kapoor et al., *Efficient Control of Air Pollution Through Plants, A Cost-Effective Alternative: Studies on Dalbergia sissoo Roxb*, 185 ENVT'L MONITORING & ASSESSMENT 7565 (2013).
[118] F. T. CAMPBELL & S. E. SCHLARBAUM. FADING FORESTS III. AMERICAN FORESTS. WHAT CHOICE WILL WE MAKE?, 17 (2014).
[119] *Id.*
[120] *Id.* at 79.
[121] *See* Saint Paul, Minnesota, Disease & Pest Management, https://www.stpaul.gov/departments/parks-recreation/natural-resources/forestry/disease-pest-management; *see also* SAINT PETER, MINN. CODE § 54-26 (2019); NEENAH, WIS. CODE § 18-23 (2019).
[122] Nancy Hughes, *Not All Trees Are Equal: Tips for tree selection*, INVEST IN THE GROUND UP, (Mar. 06, 2013) http://investfromthegroundup.org/all-trees-are-not-equal-tips-for-tree-selection/.
[123] U.S. Forest Service, Invasive Plants https://www.fs.fed.us/wildflowers/invasives/index.shtml

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problematic when the new species do not provide the same level of benefits as the native ones.[124] In order to prevent the planting of invasive tree species, municipalities have passed ordinances that do not grant invasive species protected status,[125] that prohibit the planting of listed invasive species,[126] and that exempt invasive species from the application process, fee schedule, or some other requirement associated with tree removal permits.[127] On the other hand, invasive tree species are not always seen as a bad thing. Some cities have ordinances that protect invasive species because the city has determined that the value provided by these trees as urban canopy outweighs the costs of removing and replacing it.[128] Additionally, some invasive species have been heralded as resources to draw down carbon into the soils and into the trees' biomass and have been preferred over native species.[129] This is another cost-benefit analysis that might be done best at a local level where the micro environments can be closely reviewed to determine the best course of action.

Because the costs and benefits from trees depends on the climate of the area, the types of trees that exist in the area, and the outside threat of pests and disease, cities and municipalities may feel overwhelmed when it comes to making decisions when trying to expand urban forests. Fortunately, the USFS provides several resources that can help municipalities learn about risks in their areas and help decide which trees to plant and how to maintain them best. The USFS has a web page dedicated to collected research papers on the benefits, costs, and strategic planting plans for specific climate zones.[130] The Department of Agriculture also has an entire website dedicated to providing a data base for plants that lists their native zones, potential negative impacts (such as toxicity), and other information such as height at maturity.[131]

B. Land Use, City Planning, and Urban Infrastructure Issues

Though an urban forest will generally provide a net benefit to a city, there are instances where individual trees can result in more costs than benefits. Trees, even when placed correctly, can interfere with urban infrastructure by interfering with utility lines, cracking sidewalks with root growth, damaging private and public property with fallen limbs or downed trees, and interfering with public safety and public satisfaction through leaf litter. Ideally, proper forest

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[124] *See* RICHARD J. BLAUSTEIN, *Kudzu's Invasion into Southern United States Life and Culture*, *in* THE GREAT RESHUFFLING: HUMAN DIMENSIONS OF INVASIVE SPECIES (J. A. McNeeley ed. 2001).
[125] SLIDELL, LA. CODE § 13-102 (2019).
[126] LIBERTY, MO. CODE § 30-97.4(6)(a) (2018); CHARLOTTE COUNTY, FLA. CODE § 3-9-100.3(m) (2019).
[127] *See* MONTICELLO, FLA. CODE § 54-760(i); DANIA BEACH, FLA. CODE § 825-100(a)(6) (2019).
[128] FONTANA-ON-GENEVA LAKE, WIS. CODE § 18-177(c)(4) (2018).
[129] Ian A. Dickie et al., *Conflicting Values: Ecosystem services and invasive tree management*, 16 BIOLOGICAL INVASIONS 705, 713 (2014).
[130] Pacific Southwest Research Station, *Research Topics Urban Forestry,* U.S. FOREST SERVICE https://www.fs.fed.us/psw/topics/urban_forestry/products/tree_guides.shtml (last visited Nov. 10, 2019)
[131] *See generally* Plants Data Base, U.S. DEPARTMENT OF AGRICULTURE https://plants.sc.egov.usda.gov/java/ (last visited Nov. 10, 2019).

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planning and tree maintenance can mitigate some of these issues, but this mitigation has costs. When mitigation is impossible, like if a wind storm fells trees unexpectedly, it can create unforeseen costs. Additionally, some issues can present more difficult planning challenges.

Trees can interfere with utility lines with both their upper limbs and their roots. Interference with overhead utility lines has been cited as a key factor in tree removals.[132] Additionally, utility lines planted underground are in direct competition with tree roots for space.[133] Often times, underground utility repair causes harm to the trees.[134] One suggestion for areas that already have overhead utility lines is to plant shorter trees or shrubs that can be maintained in a way so that they do not grow to a height to cause interference with the overhead power lines. But even if a tree doesn't interfere with a utility line, it may interfere with a sidewalk. Tree roots can also cause damage to sidewalks by disturbing the ground beneath them. That being said, the shading of sidewalks by the trees can also prevent damage and a study suggests that shading benefits reduce slurry resurfacing costs by 15% to 60%.[135]

Whether or not a locality permits solar can also have an impact on the cost-effectiveness of an urban forest. If a city were to implement a tree planting campaign but already has a thriving solar industry, very precise planning must take place before the actual planting can occur. This is because trees can have a negative impact on energy efficiency if they block valuable solar arrays during the winter while simultaneously being too far away from buildings to shade them from the sun that is high in its seasonal arc.[136]

Even if trees are planted with adequate planning for city infrastructure concerns, cities may run into a more difficult planning problem: lack of green space to plant trees. This is an issue that high-density cities are running into. This occurs because either the city did not create a plan that included these green spaces or existing green space is becoming maxed out and new places are not presenting themselves.[137] These problems all demonstrate the necessity to have urban forest plans and for these plans to have adequate thought and foresight when it comes to planting new trees.

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[132] Doorn & McPherson, *supra* note 108, at 204.
[133] ECOLOGY, PLANNING, AND MANAGEMENT, *supra* note 6, at 128.
[134] ECOLOGY, PLANNING, AND MANAGEMENT, *supra* note 6, at 128–29.
[135] EPA, TREES AND VEGETATION, *supra* note 31, at 8.
[136] EPA, TREES AND VEGETATION, *supra* note 31, at 3–4.
[137] *See* GEORGIA: THE STATE OF THE URBAN FOREST REPORT 2012, 16 (2013) http://www.gfc.state.ga.us/community-forests/Georgia%20-%20The%20State%20of%20the%20Urban%20Forest%20Report%202012.pdf; JEREMY GYE ET AL., CITY OF VICTORIA URBAN FOREST MASTER PLAN 29 (Feb. 2013).

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C. Residential Property and Development

Trees have the ability to markedly increase the value of private property; however, the existence of trees simultaneously drives up the costs for developers who have to contend with tree preservation ordinances.[138] The costs and benefits of trees on property are a point of contention between developers and tree conservationists. In addition, trees can cause damage to property when limbs or the trees themselves fall, [139] and some studies suggest that too many trees on a property can decrease a home's value.[140]

Several studies have found that both individual trees on private property and trees in the general vicinity are associated with higher home values. One study suggests that trees can have anywhere from a 2% to 15% increase on the sale price of a property.[141] Builders have said that, on average, a property on a wooded lot will sell for 7% more than a comparable property on an unwooded lot.[142] Further, the impact on value can be dependent on the location of the property—properties in an area of lower socioeconomic status will see greater increases in value from trees than a more affluent area.[143] Such impacts can be revitalize inner-city areas, which can have further economic benefits.

Further, the price increase is not limited to trees on private property. People are willing to pay 10%–32% more for property that is located close to various types of urban green space.[144] These increases in property values can directly increase local economies from revenue generated through property taxes. "A conservative estimate of a 5% increase in residential property values due to trees converts to $25/year on a tax bill of $500 and is equivalent to $1.5 billion/year based on 62 million single-family homes in the United States."[145]

III. Urban Forest Case Studies

This section will look at Atlanta and New York City and will give an overview of how they are managing their urban forests. These cities were selected due to our familiarity with their tree-planting initiatives, because they were recommended for review by the staff who work for the Select Committee, and because early research indicated that they had several projects associated with their urban forests. Both cities have started projects aimed to increase and protect

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[138] Kathleen L. Wolf, *City Trees and Property Values*, 16 ARBORIST NEWS 34, 36 (Aug. 2007).
[139] *See* Tenley M. Conway & Vivian Yep, *Assessing Residents' Reactions to Our Urban Forest Disservices: A case study of a major storm event*, 153 Landscape & Urban Planning 1 (2016).
[140] Francois Des Rosiers et al., *Landscaping and House Values: An Empirical Investigation*, 23 J. REAL ESTATE RESEARCH 139, 159 (2002).
[141] Wolf, *supra* note 138, at 35.
[142] NOWAK & DWYER, *supra* note 80, at 38.
[143] Wolf, *supra* note 138, at 35.
[144] Wolf, *supra* note 138, at 36.
[145] NOWAK & DWYER, *supra* note 80, at 38.

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their urban forests and several also have ordinances to memorialize their dedication to their urban forests in law. However, many of these cities have seen setbacks and failings in their projects and laws.

A. Metro-Atlanta, Georgia

The City of Atlanta is considered a shining example of how a city itself and in conjunction with nonprofits can work to protect urban forests. Atlanta has been recognized as a Tree City USA for thirty-three years and several of its metro-area cities are members too.[146] In 2010, Atlanta received municipal forestry accreditation from the *Society of Municipal Arborists* for meeting an array of requirements related to urban forestry planning and management.[147] In order to protect its renown as "a city in a forest,"[148] in 2008, Atlanta created a tree protection ordinance in order to ensure that there was no net loss of trees within the city. The ordinance was aimed to "establish and maintain the maximum amount of tree coverage on public and private lands by prohibiting the destruction and removal of trees" and to create a an urban forest plan in order to efficiently manage the urban forest as to ensure the highest return of forest benefits to its citizens.[149]

This particular ordinance required that any tree that had a diameter at breast height of six inches and was still in the ground (there were exceptions for fallen trees) required a permit before its removal, destruction, or injury could be completed.[150] The ordinance sets out definitions of activities that will be considered removal, destruction, and injury, and includes such actions as improper pruning or topping of tree growth.[151] Additionally, unless the tree was "[d]ead, dying, diseased, or hazardous [to public welfare or property]," fees were associated with the application and permit for removal.[152] The fees are determined by the following formula: $100 (number of trees removed – number of trees replaced) + $30 (total diameter inches removed – total caliper inches replaced).[153] If a person or entity removes, destroys, or injuries a

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[146] *2018 Tree City USA Communities in Georgia*, Tree City USA (June 2019) https://www.arborday.org/programs/treecityusa/treecities.cfm?chosenstate=Georgia.
[147] *City of Atlanta Receives Municipal Forestry Accreditation from the Society of Municipal Arborists*, City of Atlanta, GA (Sept. 21, 2010) https://www.atlantaga.gov/Home/Components/News/News/303/672?arch=1&npage=88.
[148] Johanna Baidya, *A City in the Forest: Atlanta's Effort to Preserve Nature in the City*, TREES ATLANTA https://www.treesatlanta.org/news/a-city-in-the-forest-atlantas-effort-to-preserve-nature-in-the-city/
[149] Atlanta, Georgia Code of Ordinances § 158-28.
[150] ATLANTA, GA., CODE § 158-101(a).
[151] ATLANTA, GA., CODE § 158-26
[152] ATLANTA, GA., CODE § 158-101(c)(1).
[153] "The difference between the number of trees removed, destroyed or injured (Nrem) and the number of trees replaced (Nrep) on a site times the established recompense value shall be calculated as partial recompense to the tree trust fund. In addition, the difference between the total diameter at breast height of the trees removed or destroyed (TDBHrem) and the total caliper inches of the trees replaced on site (TCIrep), as indicated on the approved tree

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tree without a permit, a fine of $500 per tree is assessed for first-time offenses and $1000 per tree for subsequent offenses.[154] All fees and fines collected will go to the tree trust fund, which is established for the "protection, maintenance, and regeneration of the trees and other forest resources of Atlanta."[155]

Atlanta also has smaller entities that run programs to encourage cities to protect their existing tree canopy. For instance, Atlanta's Regional Commission (ARC) is responsible for a variety of urban planning and service provision programs throughout the metro-Atlanta area. One such program is the ARC Green Communities Program, which encourages action on the part of both local governments and communities in order to move these entities into more environmentally conscious states of being.[156] This program outlines areas of environmental improvement, such as "Trees and Greenspace" and "Water Efficiency," and lists actions that cities can take within these areas. Each action is worth a set number of "points" that are then used to determine the certification level (bronze to platinum) achieved by the metro-area city or county.[157] Examples of actions include becoming a Tree City USA or the options of "(1) hav[ing] 20 acres per 1,000 residents, (2) hav[ing] at least 8 percent of total land protected for greenspace, or (3) [ensuring] all residents live within 1/2 mile walking distance."[158] This program has prompted several metro-areas to join the program—currently twenty local governments (thirteen cities and seven counties) have received certification under the program.[159]

Atlanta is also home to several nonprofits that have taken it upon themselves to ensure that greenspace is protected and tree planting is maximized. These non-profits also occasionally take responsibility for the care and maintenance of the trees that they plant and will partner with Atlanta government entities or other metro-area municipalities to assist with tree planting and maintenance in government programs. Trees Atlanta is a prime example of such an organization. With the goal of maintaining and expanding urban tree canopy, Trees Atlanta has planted and maintained over 133,000 trees since their establishment in 1986.[160] Trees Atlanta is routinely contracted by the city of Atlanta to care for trees.[161]

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replacement plan, shall be calculated as partial recompense to the tree trust fund." Atlanta, Georgia Code of Ordinances § 158-103(b).

[154] ATLANTA, GA., CODE § 158-34(a).

[155] ATLANTA, GA., CODE §§ 158-103(b), 158-66(a).

[156] *See Green Communities Program*, Atlanta Regional Commission, https://atlantaregional.org/natural-resources/sustainability/green-communities-program/

[157] *See Id.*; ATLANTA REGIONAL COMMISSION & NATURAL RESOURCES GROUP, ARC GREEN COMMUNITY CERTIFICATION MANUAL, 4 (June 2019).

[158] ATLANTA REGIONAL COMMISSION & NATURAL RESOURCES GROUP, *supra* note 157, at 43, 49.

[159] *Green Communities Program*, *supra* note 156.

[160] *History*, Trees Atlanta https://www.treesatlanta.org/who-we-are/history/.

[161] *Tree Care*, Trees Atlanta https://www.treesatlanta.org/programs/treecare/.

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Though Atlanta has implemented several programs, Atlanta is the "third most rapidly warming metropolitan region in the country."[162] Although Atlanta has not experienced much of a net change in aerial tree canopy coverage from 1951 to 2010 (50.9% to 50.2% respectively) within the city limits[163] and has not seen forest fragmentation in the central part of the metro-Atlanta area, forest fragmentation has been severe in the outer edges of the urban area.[164] In fact, of the top ten counties in the southeastern United States losing tree canopy coverage to development, three are in the metro-Atlanta area.[165] One of these counties is Fulton County—the county that most of Atlanta is located in.[166] In fact, tree coverage in Fulton County in 2018 is 16% less than in 2000, and the highest land use change was the conversion of "forest" to "settlement."[167] This is occurring despite the fact that Fulton County first adopted tree protection regulations in 1983[168] and currently has both a tree protection ordinance[169] and an ordinance-created tree planting program.[170] The main causes of the forest fragmentation are the failure of municipal tree ordinances and the unmitigated and municipal-government-sanctioned urban sprawl in the outer regions of the metro-area.[171]

Further, organizations like ARC exist to try and organize how the city will develop in the future, but they do not have enough power to force the metro areas to be greener. For instance, ARC's Green Communities Program has clearly encouraged some local communities to start maintaining and even increase urban tree canopy. However, ARC covers ten metro-area counties and seventy-two metro-area cities, which means that its Green Communities Program only has 25% of the metro-area engaged at a notable level.[172] Further, the Green Communities Program is voluntary and ARC cannot compel cities and counties to take part in it.[173]

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[162] *Georgia Tech: Understanding Urban Heat Islands at the Site Scale*, Vibrant Cities Lab, https://www.vibrantcitieslab.com/case-studies/understanding-urban-heat-islands-at-the-site-scale/
[163] Krista Merry et al., *Urban Tree Cover Change in Detroit and Atlanta, USA, 1951–2010*, 41 CITIES 123, 127, 129 (July 16 2014).
[164] Matthew D. Miller, *The Impacts of Atlanta's Urban Sprawl on Forest Cover and Fragmentation*, 34 APPLIED GEOGRAPHY 171, 176–77 (2012).
[165] TREES ATLANTA, TREES ATLANTA STRATEGIC PLAN, 2016-2020 5 (2015).
[166] *Fulton County Cities*, Fulton County https://www.fultoncountyga.gov/inside-fulton-county/cities-in-fulton-county (last visited Nov. 10, 2019).
[167] *United States, Georgia, Fulton*, Global Forest Watch, https://www.globalforestwatch.org/ (follow "Dashboard" hyperlink, select "United States" in the county query, then select "Georgia" in the "Section a region" query, lastly select "Fulton" in the second "Select a region" query) (last visited Nov. 10, 2019).
[168] GEORGIA URBAN FOREST COUNCIL, FULTON COUNTY TREE PRESERVATION PROGRAM AND ADMINISTRATIVE GUIDELINES (Nov. 2006).
[169] FULTON COUNTY, GA., CODE §§ 26-396 to -411 (2019).
[170] FULTON COUNTY, GA., CODE §§ 26-471 to -478 (2019).
[171] Miller, *supra* note 164, at 178.
[172] ATLANTA REGIONAL COMMISSION & NATURAL RESOURCES GROUP, *supra* note 157, at 1.
[173] Kristal Dixon, *Fulton County Obtains Green Community Recertification*, PATCH (Jan. 25, 2019) https://patch.com/georgia/alpharetta/fulton-county-obtains-green-community-recertification.

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There is huge potential for Atlanta and its metro area to retain its status as "a city in a forest" and ensure its urban forests continue to exist. However, this cannot be done unless forest fragmentation and removal in the surrounding areas is brought under control. Because the driving factor of the forest removal in these outer-lying areas is development,[174] it might be possible to incentivize forest preservation through mandatory forest plans and canopy coverage protection.

B. New York, New York

The economic benefits of the urban forests in New York City metropolitan are enormous. As of September 2018, New York City had an estimated 7.0 million trees. These trees provide canopy cover for over 21% of the city. New York City's urban forests store, on average, 1.2 million tons of carbon, which is valued at roughly $153 million. Every year, New York City's forests remove 51,000 tons of carbon from the atmosphere, which is valued at $6.8 million per year. In addition, New York City's urban forests are estimated to reduce residential energy costs by $17.1 million per year. Lastly, they provide a reduction in runoff by 69 million cubic feet per year, a service valued at $4.6 million per year. Due to highly valuable services that the city's urban forest provide, recent years have seen New York City invest heavily in the growth of its urban forests. It has created several projects to increase its urban forest canopy and use the forest's associated benefits to fight the impacts of climate change and protect the health of its citizens.

In 2007, New York City created the "MillionTrees NYC" initiative with the goal to plant one million trees across the city's five boroughs over the course of a decade. New York City accomplished this goal in 2015, successfully planted one million trees across the five boroughs over the course of only eight years.[175] This initiative was highly successful at increasing tree planting rapidly.[176] Other cities such as Los Angeles and Boston began tree planting campaigns but none have been as successful or ambitious at New York City's.[177]

"Cool Neighborhoods NYC" is another campaign funded by the City of New York aimed at addressing rising temperatures due to climate change.[178] Since 2017, the city has committed $82 million to fund tree plantings with a priority of focusing the plantings in areas that are

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[174] Nedra Rhone, *Atlanta's abundance of trees means homeowners can be caught off guard*, ATLANTA J.-CONSTITUTION (June 15, 2019) https://www.ajc.com/news/local/atlanta-abundance-trees-means-homeowners-can-caught-off-guard/yKcVy0EVpc54RC3qeZeP3O/

[175] Lisa W. Foderaro, *Bronx Planting Caps Off a Drive to Add a Million Trees*, N.Y. TIMES, (OCT. 21, 2015) https://www.nytimes.com/2015/10/21/nyregion/new-york-city-prepares-to-plant-one-millionth-tree-fulfilling-a-promise.html?module=inline.

[176] *Id.*

[177] *Id.*

[178] THE CITY OF NEW YORK, COOL NEIGHBORHOODS NYC: A COMPREHENSIVE APPROACH TO KEEP COMMUNITIES SAFE IN EXTREME HEAT 5 (2017).

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disproportionately vulnerable to heat waves and the risks associated with them.[179] One of their main focuses under the campaign is planting trees as a mitigation strategy to address rising temperatures and to decrease heat-related morbidity and mortality.[180]

In addition to its project, every ten years the New York City Parks Department conducts a Street Tree Census Report.[181] In 2015, the NYC Parks Department conducted their third Tree Census was able to record the location, size, species, and condition of all public curbside trees.[182] The program was called "TreesCount 2015" and involved over 2,200 citizen mapper volunteers.[183] The mapping method utilized was Tree Kit, which was designed by a local non-profit.[184] TreesCount 2015 demonstrated the success of utilizing citizen scientists to support the collection of high quality spatial data for municipal urban forest management and ongoing citizen engagement.[185] The use of citizen science saved New York City an estimated $100,112 tax dollars. [186] In addition, the program was great for connecting community members to their neighborhoods, with 70% of the volunteers who completed the survey reporting that they felt more like a part of their neighborhood.

Although New York City has seen success with its programs, it has also seen that the results of these programs do not have adequate longevity nor did they have adequate planning. For instance, the MillionTrees NYC initiative was highly successful at building excitement, energizing volunteers, and getting trees planted, but the project's long term management of the trees planted under the program has not been as successful.[187] Residents in New York City highlighted the fact that the city was already struggling to upkeep the city's current trees before the initiative began.[188] During the MillionTrees initiative, residents pointed out fears that the new trees would lead to buckling sidewalks, dangling limbs, excessive shade and leaf litter, and other issues.[189] Three of the top five calls to the New York City Parks Department involve complaints about trees.[190] These issues highlight the need for arboriculture programs to be coupled with the

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[179] *Id.* at 11
[180] *Id.*
[181] *2015 Street Tree Census Report*, NYC PARKS http://media.nycgovparks.org/images/web/TreesCount/Index.html (last visited Nov. 1, 2019).
[182] *Id.*
[183] *Id.*
[184] *Id.*
[185] *Id.*
[186] *Id.*
[187] *Step 12: Tree Planting*, VIBRANT CITIES LAB https://www.vibrantcitieslab.com/toolkit/tree-planting/ (last visited Nov. 1, 2019).
[188] Lisa W. Foderaro, *As City Plants Trees, Some Say a Million Are Too Many*, N.Y. TIMES, (Oct. 8 2011) https://www.nytimes.com/2011/10/19/nyregion/new-york-planting-a-million-treestoo-many-some-say.html?_r=0&module=inline.
[189] *Id.*
[190] *Id.*

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planting of new trees. In order to address these concerns, New York City has increased their budget allocated to tree care to $6.1 million.[191]

IV. Non-federal Programs

The USFS's Urban and Community Forestry Program (UCFP)—created pursuant to the Cooperative Forestry Assistance Act—has been a major catalyst in promoting urban forestry and increasing tree canopy in cities across the U.S. These programs have provided cities with valuable information and resources to develop their own urban forestry programs. In developing the UCFP, the USFS has partnered with non-federal organizations. These organizations have provided financial, informational, and resource assistance to urban forest programs across the country. We have outlined the work of each of these organizations below.

A. Arbor Day Foundation

The Arbor Day Foundation (ADF) is a non-profit conservation and education organization that works on inspiring citizens to plant, nurture, and celebrate trees. They are currently the largest non-profit membership organization dedicated to planting trees. In 2018, the total net assets of the organization totaled almost $37.2 million.[192] They have numerous programs dedicated to increasing tree growth across the country. The three main programs they operate are aimed at: (1) replanting the nations forests helping to restore habitat and forest ecosystems; (2) Tree City USA which aims to increase tree growth in communities across the US; and (3) Community Tree Recovery which delivers new trees to communities after natural disasters.

Below we briefly discuss a few of ADF's programs that relate specifically to urban forestry including Tree City USA, Energy-Saving Trees Program, and Community Canopy Program.

i. Tree City USA

In 1976, Tree City USA launched a national recognition program through a partnership with the USFS and the National Association of State Foresters.[193] The program outlined the benefits communities would gain if they developed urban forests and aimed to provide the framework necessary for communities to manage and expand their public trees.[194] Currently there are more than 3400 communities that have committed to becoming a Tree City USA. There

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[191] Lisa W. Foderaro, *Bronx Planting Caps Off a Drive to Add a Million Trees*, N.Y. TIMES, (OCT. 21, 2015) https://www.nytimes.com/2015/10/21/nyregion/new-york-city-prepares-to-plant-one-millionth-tree-fulfilling-a-promise.html?module=inline

[192] ARBOR DAY FOUNDATION, 2018 ANNUAL REPORT 29 (2019).

[193] *What is Tree City USA?*, Arbor Day Foundation https://www.arborday.org/programs/treecityusa/about.cfm (last visited Nov. 10, 2019).

[194] *Id.*

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are four core standards that are required for a community to become a Tree City USA these are (1) maintaining a tree board or department; (2) having a community tree ordinance; (3) spending at least $2 per capita on urban forestry; (4) having arbor day proclamation and observance celebration.[195] This program has created and helped to sustain urban forestry programs across the nation.

ii. Energy-Saving Trees Program and Community Canopy Program

Under these two programs, homeowners across the U.S. are strategically planting trees in partnership with local utility providers, public agencies, and other organizations. The program specifically distributes free trees to utility companies, municipalities, and corporate organizations in order for them to then be distributed to local citizens within their communities.[196] The core purpose of these programs are to provide the environmental and public health benefits of urban forests to lower energy bills, improve air quality, sequester carbon and manage stormwater runoff.

Under these programs, individual citizens can use the online I-Tree technology to personally plot their land as mapped from satellite imagery. With his imagery citizens can select a tree that would be best suited to their property, and select the right location for the planting that would yield the best energy and cost savings. In 2018, this program distributed 52,000 trees though 70 partners across the country.[197]

B. American Forests

American Forests is the oldest conservation organization in the country.[198] The organization has been a crucial in forest policy in the U.S. and specifically have helped create the field of urban forestry in the U.S.[199] In 1978, American Forests organized the first National Urban Forestry Conference which helped to draft what would create the USFS's UCFP in the 1990 Farm Bill.[200]

American Forests was also a leading organization in the development of the Sustainable Urban Forests Coalition.[201] The Sustainable Urban Forests Coalition is a network of non-profits,

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[195] TREE CITY USA, TAKE PRIDE IN A GREENER COMMUNITY, https://www.arborday.org/programs/treecityusa/bulletins/documents/000-full.pdf
[196] ARBOR DAY FOUNDATION, *supra* note 192, at 19.
[197] ARBOR DAY FOUNDATION, *supra* note 192, at 19.
[198] *American Forests History*, American Forests https://www.americanforests.org/about-us/history/ (last visited Nov. 13, 2019).
[199] *Id.*
[200] Ian Leahy, *Innovations in Urban Forestry*, AMERICAN FORESTS (2016) https://www.americanforests.org/magazine/article/innovations-in-urban-forestry/.
[201] *Id.*

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businesses, associations, foundations, and other organizations working to advance sound and effective urban forest policy and practices.[202]

C. National Association of State Foresters

The National Association of State Foresters (NASF) is a non-profit organization composed of directors of forestry agencies in all fifty states in the U.S., in addition to U.S. territories, and the District of Columbia. The NASF is a leading authority on forest policy and aims to promote and advance state and private forestry in the U.S.[203] Through public-private partnerships, the association aims to promote programs and activities that advance the protection and conservation of state forest resources including urban forests.[204] The association also assists with the development of state Forest Action Plans pursuant to the 2008 Farm Bill, that provide an in-depth analysis of forest conditions and trends in each state.[205]

V. Existing Federal Programs

There are two main federal programs that support the development and management of urban forests. These two programs are the Urban and Community Forest Program and the Land and Water Conservation Fund. Below we describe each of these programs and how they assist with the management and development of urban forests.

A. The Urban and Community Forestry Program

The Cooperative Forestry Assistance Act of 1978 (CFAA) directed the Secretary of Agriculture (Secretary) to assist with the maintenance of non-federal forest lands.[206] Specifically, the purpose of the Act to offer assistance pertaining to non-federal and international forest lands in ten areas. The overarching goal of the Act is to establish "a coordinated and cooperative Federal, State, and local forest stewardship program for management of the non-Federal forest lands"

Relevant to urban forests is sub-section 7 which directs the Secretary to assist in "the planning and conduct of urban forest programs." Under this Act, the Secretary was directed to provide "urban and community forest assistance."[207] The purpose of this section of the Act was to:

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[202] SUSTAINABLE URBAN FORESTS COALITION, WHO IS THE SUSTAINABLE URBAN FORESTS COALITION?, https://urbanforests.wpengine.com/wp-content/uploads/2019/02/SUFC_FactSheet.pdf
[203] *Id.*
[204] *Id.*
[205] *State Forest Actions Plans*, National Association of State Foresters. https://www.stateforesters.org/forest-action-plans/ (last visited Nov. 14, 2019)
[206] 16 U.S.C. § 2101(b).
[207] 16 U.S.C. § 2105.

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> (1) improve understanding of the benefits of preserving existing tree cover in urban areas and communities;
> (2) encourage owners of private residences and commercial properties to maintain trees and expand forest cover on their properties;
> (3) provide education programs and technical assistance to State and local organizations (including community associations and schools) in maintaining forested lands and individual trees in urban and community settings and identifying appropriate tree species and sites for expanding forest cover;
> (4) provide assistance through competitive matching grants awarded to local units of government, approved organizations that meet the requirements of section 501(c)(3) of Title 26, or other local community tree volunteer groups, for urban and community forestry projects;

Pursuant to this directive the USFS created the Urban and Community Forestry Program (UCFP).[208] The UCFP's goal is to create a program that "supports forest health for all of our Nation's forests, creates jobs, contributes to vibrant regional wood economies, enhances community resilience, and preserves the unique sense of place in cities and towns of all sizes."[209] In attaining this goal, the UCFP works with "state partners to deliver information, tools and financial resources, the program supports fact-based and data-driven best practices in communities, maintaining, restoring, and improving the more than 140 million acres of community forest land across the United States."[210]

The UCFP is authorized to provide financial, technical, and related information to state foresters or equivalent state officials for the purposes of encouraging states to provide assistance to units of local governments that will encourage the planning of urban forest programs.[211] In providing this assistance the UCFP is also authorized to cooperate with interested members of the public including non-profit organizations.[212] In promoting urban forests, this section of the Act created four main ways of assistance: (1) programs providing technical and educational assistance, (2) programs providing financial assistance, (3) creation of an urban forestry advisory council, (4) development of an urban and community action plan.[213] Below we outline each of these areas of assistance and highlight actions of the USFS's UCFP under each program.

i. Educational Assistance

The UCFP in cooperation with State officials and other interested parties implements a program of educational and technical assistance for urban and community forest resources.[214]

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[208] *Urban and Community Forestry Program*, U.S. Forest Service https://www.fs.fed.us/managing-land/urban-forests/ucf (last visited Nov. 13, 2019).
[209] *Id.*
[210] *Id.*
[211] 16 U.S.C. § 2105(c).
[212] *Id.*
[213] *Id.*
[214] 16 U.S.C. § 2105(d).

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This program directs assistance in numerous ways including assisting state and local governments with: conducting inventories of their forest resources, identifying opportunities for establishment of plantings, organizing and conducting urban and community forestry projects and programs, improving education and technical support in selecting tree species, improving proper tree care and maintenance, protecting individual trees and preserving existing open spaces, assisting with the development of management plans for trees within communities, and increase public understanding of the environmental and public health benefits of trees and open spaces.

In 2015, the USFS released their Strategic Plan: FY 2015–2020 (Strategic Plan).[215] This plan included the strategic goals of advancing knowledge gathered by the agency's programs, and developing effective technologies and applications to address forest sustainability and share these technologies with partners to promote global forest sustainability.[216] The USFS created an Action Plan for improved urban forest science delivery for 2019–2020.[217] The action plan aimed to disseminate social, ecological, and economic science, technology, and information to improve the long-term sustainability of urban forests. The plan outlines a comprehensive delivery system for urban forestry research, information, and technology.

In addition to the Strategic Plan, the UCFP has developed numerous technologies and programs aimed at assisting with urban forestry development. These technologies include i-Tree, Vibrant Cities lab, a webinar series, Urban Field Stations, and Urban Forestry Inventory Analysis. Below we briefly outline each of these technologies and programs:

a. i-Tree

The USFS provides a peer-reviewed software service called i-Tree in order to facilitate forest management in both urban and rural areas by "quantifying forest structure and the environmental benefits that trees provide."[218] I-Tree can be used to quantify the ecosystem services that trees provide, allowing users to link forest management activities to environmental quality benefits. i-Tree offers an array of programs including: i-Tree MyTree; i-Tree Landscape; i-Tree Design; i-Tree Canopy; i-Tree Eco; i-Tree Hydro; i-Tree pest.[219] Each of these i-Tree programs provides a way to input different forestry management plans and calculate the benefits or damage that plan will cause. I-Tree is also used for Forest Inventory Analysis (FIA) which is conducted by the USFS on an annual basis on federal lands and more recently has begun to be conducted on urban non-federal forest lands (See Urban FIA below for a more detailed description of this program).

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[215] USDA FOREST SERVICE STRATEGIC PLAN: FY 2015–2020, USDA (2015).
[216] *Id.*
[217] U.S. FOREST SERVICE, ACTION PLAN FOR IMPROVED URBAN FOREST SCIENCE DELIVERY (Aug. 2018).
[218] *About: What is i-Tree?*, i-Tree, https://www.itreetools.org/about (last visited Nov. 10, 2019).
[219] *Tools*, i-Tree, https://www.itreetools.org/tools (last visited Nov. 10, 2019).

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b. Vibrant Cities Lab

Part of the USFS's Strategic Plan included the launch of Vibrant Cities Lab in November 2017 to assist city managers, policymakers and advocates in building thriving urban forest programs.[220] Vibrant Cities Lab is designed to assist communities in discovering the benefits of urban forests and increased tree canopy. Vibrant Cities Lab is an immensely useful program for assisting communities in starting to enhancing their already existing urban forestry programs. It was developed in partnership with the USFS, American Forests, and the National Association of Regional Councils.

The program syntheses the research on the benefits of urban forests, provides case studies on what other cities across the country have done, and provides a toolkit for assessing their current tree coverage and how they can increase tree coverage. The program provides the best available science on urban forestry and provides an Urban Forestry Toolkit which is a step-by-step guide on implementing a local urban forestry program. The Urban Forestry Toolkit (Toolkit) is a 16-step process that urban planners can follow to initiate an urban forestry program. The Toolkit begins with an assessment of a community's urban tree canopy and a street tree inventory. The Toolkit allows you to make an account with Vibrant Cities Lab and run a Community Assessment which outlines goals for creating a productive urban forestry program for each community.

Next, the Toolkit helps prioritize areas that should be targeted for planting using a variety of factors. After that the Toolkit assists communities in organizing and finding stakeholders. Next, the Toolkit helps create an actual plan for implementing a program. The Toolkit offers a multiple examples of urban forest plans from cities across the country. In addition, to resources on how to set tree canopy goals for US cities. The Toolkit also addresses how to promote better forestry on private lands and outside the cities borders. Following the creation of a urban forestry plan the Toolkit provides tools on implementing policies across agencies at the local and state level that support urban forest sustainability.

Lastly, the Toolkit provides resources for ensuring the continued monitoring and maintenance of urban forests once a program has been created. The Toolkit provides resources on how to address continued funding necessary to implement the program. The Toolkit also gives communities a way to compare their urban forestry program to other urban forestry programs across the country. Overall, Vibrant Cities Lab is an immensely useful resource for communities across the nation in implementing successful and sustainable urban forestry programs.

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[220] *About*, Vibrant Cities Lab, https://www.vibrantcitieslab.com/about/ (last visited Nov. 13, 2019).

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c. Webinar Series

In addition, the UCFP also launched a national webinar series 'science, policy, and practice' to provide the best available science to urban sustainability professionals. The UCFP outlined a goal of holding ten webinars each fiscal year.[221] These webinars provide valuable information on the benefits of urban forestry, the tools needed to begin urban forestry programs, and the best available science on emerging issues such as pests, insects and other issues.

d. Urban Field Stations and Urban Forestry Inventory Analysis

The 2019–2020 Action Plan also outlined two developing programs: urban field stations and Urban Forest Inventory Analysis (FIA). Historically, the USFS has maintained a network of experimental forests to provide for long-term science and management studies. Urban field stations are the urban counterpart and are research units and facilities managed to provide research on urban forest ecology.[222] Each urban field station is both a physical place and an extensive network of interdisciplinary scientists and partners working on developing research, gathering data, and using collected science to improve the quality of urban forests.[223] The USFS Northern Research Station currently operates five Urban Field Stations in New York, NY; Baltimore, MD; Chicago, IL; Philadelphia, PA; and Springfield, MA.

FIA's are aimed at creating tree census's which allow the USFS to evaluate the sustainability of current forest management practices.[224] Historically FIA's have been conducted on federal USFS lands across the country.[225] More recently, the USFS has begone conducting FIA's on urban non-federal forest lands. The Urban FIA program is currently growing across the nation with twenty-six cities participating.[226] The USFS's goal is to increase participation across the country to build a strategic, national inventory of urban forests. The program includes an annual inventory of trees in urban areas which provides key data on the extent, volume, status, and trends of urban trees and forests.

ii. Financial Assistance

The UCFP was also authorized to provide financial assistance to enhance urban forests. Specifically, the UCFP was directed to assist State foresters or State officials with procuring plant materials for the purpose of reforesting open spaces.[227]

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[221] U.S. FOREST SERVICE, *supra* note 214
[222] U.S. FOREST SERVICE, IMPROVING THE LIVES OF ALL AMERICANS: U.S. FOREST SERVICE URBAN FIELD STATIONS (Aug. 2016).
[223] *Id.*
[224] *We are the Nation's Forest Census*, USDA Forest Service https://www.fia.fs.fed.us/ (last visited Nov. 13, 2019).
[225] *Id.*
[226] U.S. FOREST SERVICE, FY 2020 BUDGET JUSTIFICATION (Mar. 2019).
[227] 16 U.S.C. § 2105(e).

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Pursuant to this Act the Secretary was directed to establish an urban community forestry challenge cost share program.[228] Funds and support are made available under such program to eligible communities on a competitive basis for urban and community forestry projects.[229] The criteria for how these funds were to be awarded was developed by the National Urban and Community Forestry Advisory Council.[230] Funds for the grant are to support national urban and community forestry projects on nonfederal public land that have "a national or multi-state impact and application."[231] The criteria developed by the Forestry Advisory Council "seeks innovative grant proposals for program development, study, and collaboration that will address strategies in the National Ten Year Urban Forestry Action Plan."[232] For the 2019 fiscal year, the UCFP provided $900,000 in grant funds.[233] The federal share of support for a project was not to exceed 50 percent on a matching basis. [234]

iii. Community Forest and Open Space Conservation Program

The Secretary was directed to create a Community Forest and Open Space Conservation program in which the Secretary awards grants to "eligible entities" to purchase private forest land.[235] The private land must be threatened by conversion to non-forest uses; and provide public benefits to the community.[236] Federal grants may not cover more than 50 percent of the cost of the private land and must be matched by the non-federal eligible entity.[237] Eligible entities include local governmental entities, Indian tribes, or nonprofit organizations.[238]

iv. Forestry Advisory Council

The Secretary was directed to establish a National Urban and Community Forestry Advisory Council. The purpose of the Advisory Council was to develop a national urban and community forestry action plan, evaluate and implement the plan, and develop criteria for and submitting recommendations with respect to, the urban and community forestry challenge cost-share program.[239] The council consists of fifteen members appointed by the Secretary.[240] Appoints by the Secretary must represent:

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[228] 16 U.S.C. § 2105(f).
[229] USFS. 2019 U.S. Forest Service National Urban and Community Forestry Challenge Cost-Share Grant Program. (2019) https://www.fs.fed.us/ucf/supporting_docs/fy2019/grants/2019-RFP-NatlUrbanForestryRFP.pdf
[230] *See infra* Section V.A.iv.
[231] *USFS 2019,* Forest Service National Urban and Community Forestry Challenge Cost-Share Grant Program.
[232] *Id.*
[233] *Id.*
[234] 16 U.S.C. § 2105(f)(2).
[235] *Id.*
[236] 16 U.S.C. §§ 2103d(c)(1)(A)–(B).
[237] 16 U.S.C. §§ 2103d(c)(2)–(3).
[238] 16 U.S.C. § 2103d(a)(1).
[239] 16 U.S.C. §§ 2105(g)(1)(A)–(C).
[240] 16 U.S.C. § 2105(g)(2)(A).

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- National nonprofit forestry and conservation citizen organizations (2);
- State, county, and city or town governments (1 each);
- Forest products, nursery, or related industry (1);
- Urban forestry, landscape or design consultant (1);
- Academic institutions, with relevant expertise (2);
- State forestry agencies (1);
- Professional renewable natural resource or arboricultural society (1);
- USDA Extension Service (1);
- USDA Forest Service (1); and
- others with expertise and experience in urban and community forestry and who are not governmental officers or employees, at least one of whom is a resident of a community of fewer than 50,000 people (2).[241]

v. Urban and Community Forestry Action Plan

Lastly, the Council was required under this Act to develop an Urban and Community Forestry Action Plan. Beginning in 1990 and every ten years thereafter.[242] This plan is to include an assessment of the current status of urban forest resources in the U.S., a review of urban and community forestry programs in the U.S. including educational and technical assistance programs, recommendations for improving the status of urban forests, a review of urban forestry research including recommendation for new research and summary of research priorities, proposed criteria for evaluating proposed projects under the urban and community forestry challenge cost share program, and lastly an estimate of the resources needed to implement the National Urban and Community Forestry Action Plan for the succeeding ten years.[243]

B. Land and Water Conservation Fund

The Land and Water Conservation Fund (LWCF) was established in 1965 in order to ensure that current and future generations of Americans had continuing access to land and water recreation areas.[244] Currently, the LWCF receives money for three general purposes: "(1) federal acquisition of land and waters and interests therein; (2) the state grants for recreational planning; acquiring recreational lands, waters, or related interests; and developing outdoor recreational facilities; and (3) related purposes."[245] Since 1978, the LWCF is authorized to receive $900 million annually and receives some additional funds through the Gulf of Mexico Energy Security

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[241] *Id.*
[242] 16 U.S.C. § 2105(g)(3).
[243] 16 U.S.C. §§ 2105(g)(3)(A)–(F).
[244] Land and Water Conservation Fund Act of 1965, Pub. L. No. 88-578, 78 Stat. 897.
[245] CAROL HARDY VINCENT, CONG. RESEARCH SERV., RL33531, LAND AND WATER CONSERVATION FUND: OVERVIEW, FUNDING HISTORY, AND ISSUES 3 (June 19, 2019).

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Act of 2006.[246] None of these funds are tax payer dollars,[247] but rather come from a variety of sources, with the main source being revenue from offshore gas and oils projects.[248] As of 2019, the LWCF is permanently authorized to receive its $900 million annual cap.[249]

The state grant program of the LWCF has provided funding for roughly 42,000 outdoor recreation projects[250] in every county in the U.S., including Hawaii and Alaska.[251] The grant program is administered by the National Parks Service and the LWCF Act has a fund apportionment equation to ensure that each state receives some level of equal funding.[252] The LWCF grants are made to match up to 50% of a project's funding,[253] and the Act has provided $4.6 billion through these grants.[254] A project can include the acquisition of lands or water areas for recreation, creating or updating recreation facilities, or funding recreation planning programs.[255] However, before a state can even be considered for funding, the chief executive of the state must create a comprehensive statewide outdoor recreation plan with the input of the public.[256]

VI. Policy Recommendations

Below we outline five policy recommendations (1) continued and expanded support of the UCFP, (2) expanding grants available under the UCFP, (3) incentivizing cities to adopt urban forestry programs, (4) creating tax incentives for private landowners to increase canopy cover, and (5) changing the funding allocation scheme within the Land and Water Conservation Fund.

A. Continued and Expanded Support of the Urban and Community Forestry Program

Since 2009, the UCFP has received on average $30 million every fiscal year.[257] Since 2018, the USFS has proposed to cut the budget of the UCFP.[258] The current USFS

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[246] *Id.*; Gulf of Mexico Energy Security Act of 2006 (GOMESA), P.L. 109-432, Division C, §105.
[247] LAND AND WATER CONSERVATION FUND: GIVING BACK TO YOU AND YOUR COMMUNITY (Nov. 2014) https://edit.doi.gov/sites/doi.gov/files/migrated/lwcf/about/upload/LWCF_Urban.pdf. [hereinafter GIVING BACK TO YOU AND YOUR COMMUNITY].
[248] VINCENT, *supra* note 236, at 1.
[249] 116 P. L. 9, § 3001(a), 133 Stat. 580 (2019); 54 U.S.C. § 200302 (2019).
[250] VINCENT, *supra* note 236, at 7.
[251] GIVING BACK TO YOU AND YOUR COMMUNITY, *supra* note 238. *See Map of LWCF*, LWFC https://www.lwcfcoalition.com/map-of-lwcf (last visited Nov. 11, 2019).
[252] 54 U.S.C. § 200305(b) (2019).
[253] 54 U.S.C. § 200305(c) (2019).
[254] VINCENT, *supra* note 236, at 9.
[255] VINCENT, *supra* note 236, at 7.
[256] 54 U.S.C. § 200305(d)(1) (2019).
[257] https://nationalaglawcenter.org/wp-content/uploads/assets/crs/RL31065.pdf
[258] https://www.fs.fed.us/sites/default/files/media_wysiwyg/usfs-fy-2020-budget-justification.pdf

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administration's proposed budget for 2020 calls for a complete defunding of the UCFP.[259] The justification for this budget cut is to focus services on "reducing wildland fire risk, contributing to the improvement of the forest and grassland conditions across shared landscapes, and contributing to rural economic prosperity."[260] Our primary policy recommendation is to ensure continued funding and support of the UCFP.

The UCFP has provided ample technical and informational resources to increase urban forestry programs across the country. With the launching of Vibrant Cities Lab, state and local planners now have access to all the tools necessary to initiate urban forestry projects. The policy question now is how to encourage more cities across the U.S. to begin to develop urban forestry plans and how to encourage cities with urban forestry plans to continue to increase canopy coverage and develop tree maintenance programs. Beyond continuing to financial support the UCFP, we outline policy recommendations in which the federal UCFP could further increase and encourage urban forest growth.

B. Expanding Grants Available for Urban Forestry Projects

There are two grants programs managed by the UCFP that relate to urban forestry projects (1) Urban Community Forestry Challenge Cost Share Program; and (2) Community Forest and Open Space Conservation program.

The Urban Community Forestry Cost Share Program provides grants to any non-federal organization and tribal agency to support national urban and community forestry projects on nonfederal public land that have a national or multi-state impact and application.[261] This program is a matching grant program. For the 2019 fiscal year, the UCFP provided $900,000 in grant funds. This particular grant program is to encourage the protection of forest resources on already publicly owned land.

The other UCFP grant, Community Forest and Open Space Conservation Program, provides an opportunity for communities to acquire and conserve forests that "provide access and recreational opportunities, protect vital water supplies and wildlife habitat."[262] This program provides for the physical acquisition of lands in full fee title to local governments and non-profit

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[259] *Id.*
[260] *Id.*
[261] U.S. FOREST SERVICE, 2019 U.S. FOREST SERVICE NATIONAL URBAN AND COMMUNITY FORESTRY CHALLENGE COST-SHARE GRANT PROGRAM (Apr. 30, 2018).
[262] *How the Community Forest Program Works*, U.S. Forest Service https://www.fs.fed.us/managing-land/private-land/community-forest/program (last visited Nov. 14, 2019).

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organizations.[263] In the 2019 fiscal year, the program provided $4,000,000 in grants for the acquisition of 15 community forests.[264] This is also a matching grant program.

Our policy recommendation is to expand both of these grant programs to further provide support for urban forest expansion. Right now, UCFP is limited in the number of projects and community forests it can fund. Providing for the expansion of these grant programs would create an increase in urban forests in communities across the country.

C. Incentivize Cities to Adopt Urban Forest Plans.

There are multiple ways to incentivize the development of urban forest plans in cities across the U.S. First, the UCFP has provided informational assistance on the benefits or urban forests and specific actions to take to develop and implement urban forestry programs. In order to continue assisting communities in developing urban forestry plans it is important that the UCFP continue to provide the best available information to communities through platforms such as the Vibrant Cities Lab and their Urban Forest Webinar series. As mentioned above, the USFS current proposed budget for 2020 calls for a complete defunding of the UCFP. It is important that the UCFP is not defunded in order to ensure the sustainability of the information and technology assistance it provides.

Second, a federal statutory mandate could be implemented to require that cities over a certain size (ex. 1,000,000 residents) develop urban forestry plans in order to increase urban forest cover. This would target larger cities and require the development of urban forest plans. The requirement that cities meet this statutory mandate could be tied to a specific federal funding source such as housing, transportation, publicly owned treatment works, water resources, or other federal funding. Congress could consider requiring cities to develop maintain and implement an urban forestry plan in order to maintain their eligibility for these streams of federal revenues and resources.

D. Create Tax Incentives for Increased Canopy Cover and Tree Maintenance on Private Lands

Another policy recommendation for increasing canopy coverage is a plan to target private lands. Canopy coverage on private lands in urban areas is equally as important as targeting public lands. One recommendation for increasing canopy coverage on private lands is to create a property tax incentive that would create a benefit for private lands owners to plant trees and provide tree maintenance.

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[263] *Id.*
[264] U.S. FOREST SERVICE, FISCAL YEAR 2019 COMMUNITY FOREST PROGRAM FUNDED PROJECTS https://www.fs.fed.us/sites/default/files/2019-07/fy2019-cfp-funded-projects.pdf

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One element of a program such as this would require an auditing process to ensure that private land owners meet the requirements for the tax incentive. An entity would have to be chosen to provide auditing services. Possible auditors could be a state forester or other state entity that would provide certification that private landowners were meeting the tax incentive

E. Alter the Appropriations Scheme for the Land and Water Conservation Fund

Though the LWCF is allowed to receive up to $900 annually, Congress has rarely ever allocated this full amount to the LWCF.[265] Additionally, the LWCF cannot spend any of these funds unless the funds are appropriated to it by Congress.[266] That being said, Congress has a poor track record of actually funding the LWCF—only half of the funds ever in LWCF's coffers have ever actually been allocated for use by the LWCF,[267] while the majority of the remaining funds has been siphoned off for other, non-conservation uses.[268] And despite receiving some funding for the 2019 fiscal year, President Trump has proposed a 105% cut to LWCF funding—meaning none of the annual $900 million would come in and some unappropriated money from previous years would be pulled out.[269] Thus, the LWCF should be allocated the maximum funds available to it and should be appropriated all of these funds.

In addition to actually appropriating all of the funds that the LWCF is entitled to, the allocation of these funds within the LWCF among its three general purposes needs revision. During the existence of the Act, the land acquisition purpose has received 60% of available funds, the state grant program has received 26%, and the "other interests" has received 14%.[270] However, since fiscal year 2000, the state grants program has only received more than 20% of yearly available funds six times, dropping the most recent ten-year average allocation of funds to this program to 23%.[271]

Lastly, the funds can only be used for projects on land that will be used for public recreation in perpetuity.[272] Though this may limit the utility of the fund when it comes to protecting urban forests, at the very least it can ensure that states can give cities funding to adequately maintain and care for trees in urban parks. When disseminating information about the LWCF grants, we suggest that there be a push to suggests to states to ask for money to help

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[265] Elliott D. Woods, *The Land and Water Conservation Fund Is Dead*, OUTSIDE (Oct. 5, 2018) https://www.outsideonline.com/2350166/lwcf-dead-congress-murkowski; VINCENT, *supra* note 236, at 13–15.
[266] VINCENT, *supra* note 236, at 2.
[267] VINCENT, *supra* note 236, at 2.
[268] *#FundLWCF*, LWCF https://www.lwcfcoalition.com/fundlwcf (last visited Nov. 11, 2019).
[269] *Id.*
[270] VINCENT, *supra* note 236, at 9.
[271] VINCENT, *supra* note 236, at 9–10.
[272] VINCENT, *supra* note 236, at 7.

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protect trees on lands dedicated to recreation. This protection could be establishing a protocol for dealing with disease or helping with tree planting and maintenance programs to ensure these recreation areas have high levels of canopy coverage.

Conclusion

Urban Forests provide immense environmental benefits and are crucial to addressing global climate change. Our paper outlines the major federal and non-federal actors working to grow urban forests in communities across the country. Based on our research we outlined five potential policy recommendations that will support the continued growth and expansion of urban forests across the country. These policy recommendations are: (1) continued and expanded support of the UCFP; (2) expanding grants available under the UCFP; (3) incentivizing cities to adopt urban forestry programs; (4) creating tax incentives for private landowners to increase canopy cover; and (5) changing the funding allocation scheme within the Land and Water Conservation Fund.

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