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ABSTRACT

This paper discusses the planting of trees in areas where tree canopy is lacking as both mitigation and adaptation measures to climate change. I argue that cities must prioritize planting trees in low-income neighborhoods as a form of mitigation from extreme heat because those areas tend to be hotter than wealthier areas of the same city. The shade provided by trees will cool the area and reduce health impacts and mortality during extreme heat events. Section I discusses the urban heat island effect and how redlining is directly connected to low tree canopy. Section II highlights initiatives cities have taken to increase their tree canopy and indicate where they fall short. Finally, Section III provides different models cities can emulate to require tree planting and incentives cities can provide to developers and owners of apartment buildings in order to increase tree canopy in low-income neighborhoods. These regulations can come in the form of city ordinances. Incentives can be in the form of stormwater credits or fee discounts per tree preserved or planted, provide density bonuses for increase in tree canopy, or provide partial funding to owners of apartment complexes that lack trees.

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INTRODUCTION

More people die from heat-related deaths annually in the US than from any other weather related disaster.[1] Climate change is exacerbating extreme heat; it is projected that extreme heat days will increase in number, intensity, and duration.[2] This is especially true of urban areas where the built environment leads to temperatures being, on average, 10°F greater than in neighboring rural or suburban areas.[3] This is known as the urban-heat island effect.[4] However, there are also great disparities in temperatures within cities, with low-income areas experiencing higher temperatures than their wealthier counterparts.[5] Thus, even in urban areas, some residents are more at risk from extreme heat events than others. This is an environmental justice issue, which is the principle that all people are entitled to equal environmental protection regardless of race, color, or national origin.[6]

There is one simple step cities can take to mitigate extreme heat: planting more trees. Trees provide shade for people walking, cool the area and buildings, sequester carbon, and capture stormwater.[7] Many cities have adopted some form of tree planting initiative. These programs usually provide private citizens with a free tree to plant on their property.[8] Even with these types of programs there continue to be disparities in where trees are planted, thereby, granting benefits to some neighborhoods and not others. [9]

This paper will answer the question of how cities can provide shade, specifically to low-income communities, as a form of mitigation – by sequestering carbon and reducing the need to use air conditioners – and adaptation to climate change. Cities must take step to safeguard those most prone to the effects of climate change.

The first part of this paper will focus on temperature and tree canopy disparities within urban cities. The second part will discuss the various methods cities have adopted to increase their tree canopy and analyze which have been more effective. The final section will focus on regulations

1. Ann E. Carlson, *Heat Waves, Global Warming, and Mitigation*, 26 UCLA J. Envtl. L & Pol'y 169, 172 (2008).
2. *Id.* at 170.
3. *Id.* at 213.
4. *Id.*
5. Meg Anderson, & Sean McMinn, *As Rising Heat Bakes U.S. Cities, the Poor Often Feel It Most*, NPR (Sept. 3, 2019). https://perma.cc/XB4Z-7ZV4
6. Oliver Milman. *Robert Bullard: 'Environmental justice isn't just slang, it's real.'* THE GUARDIAN (Dec. 20, 2018), https://perma.cc/84XN-TVX2.
7. Sam Bloch, "Shade", *Places Journal* (Apr. 2019), https://perma.cc/X2ZA-U94Y.
8. *Id.*
9. *Id.*

and incentives cities can adopt that will increase tree canopy, especially in low-income areas. This includes adopting a city ordinance that requires developers to plant trees on private property, providing density bonuses for increases in tree canopy, or provide partial funding to owners of apartment complexes that lack trees.

I. TREE CANOPY AND URBAN HEAT INEQUITIES

Journalist Sam Bloch claims that "Shade is an index of inequality . . . "[10] Shade is distributed unequally, primarily because dense urban areas are not designed to accommodate trees and vegetation and because the cost of maintaining trees is high, with wealthier individuals being able to plant them in their private homes.[11] This lack of trees is an environmental justice issue because the lack of shade is concentrated in low-income and people of color neighborhoods where extreme heat will only be exacerbated as climate change takes hold. This section will focus on tree canopy disparities within cities.

A. URBAN HEAT ISLAND EFFECT

The urban heat island effect is a phenomenon that impacts city temperatures. It occurs where the city is significantly warmer than the neighboring suburban and rural areas.[12] Temperature difference between the city and the surrounding suburban and rural areas can be between 1.8–5.4°F warmer.[13] In the evening, the difference can be as high as 22°F.[14] This is due primarily to the lack of greenspace and trees and the materials used to build the city: concrete, asphalt, pavement.[15] Concrete, asphalt and pavement are nonreflective and retain heat.[16] Numerous vehicles and reduced air flow between tall buildings also contributes to heating.[17] Greenspace and trees have been proven to have a cooling effect.[18]

10. Bloch, *supra* note 7.

11. *Id*.

12. Jillian C. Kirn, *Mitigation of Urban Heat Islands: Greening Cities with Mandates versus Incentives*, 32 NAT. RESOURCES & ENV'T 40, 40 (2018).

13. Urban Heat Island Basics. In: *Reducing Urban Heat Islands: Compendium of Strategies*. U.S. Environmental Protection Agency, at 1 (2008). https://perma.cc/JAK8-8D5D.

14. *Id.*

15. Jeremy S. Hoffman et al.,*The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas*, MDPI, CLIMATE, Jan. 13, 2020, at 2.

16. Kirn, *supra* note 12, at 40.

17. Carlson, *supra* note 1, at 213.

18. Hoffman et al., *supra* note 15, at 2.

Evapotranspiration – the process of plants and vegetation releasing water into the air – has a cooling effect as well, but it does not have as big an impact in cities because there are less plants and soil to retain storm water.[19] Moreover, temperature differences are more drastic at night, when cooler air results in faster temperature drops in rural areas than in cities.[20] Night time is also when the heat absorbed by building is radiated back.[21] Cities classified as urban heat islands usually have lower air quality and an increase in pollutants.[22]

The urban-heat island effect is expected to cause more damage as climate change warms the world. Extreme heat is the leading cause of summertime morbidity and is especially dangerous for individuals with pre-existing health conditions, people with limited access to resources, and the elderly.[23] The number of deaths and illness resulting from extreme heat are expected to rise as extreme heat days increase in number and intensity due to climate change.[24] Currently, approximately 1,500 heat-related deaths occur each year in the U.S.[25]

The health impacts of extreme heat are devastating. Extreme heat can cause rapid rises in heat gain in the human body.[26] When the body cannot regulate its temperature, various illnesses result: heat cramps, heat exhaustion, heatstroke, and hyperthermia.[27] Deaths from heatstroke are the most common, which occur when the body heats to at least 105°F and cannot cool itself.[28] Those who do survive heat stroke maintain a high risk of organ failure and death within a year.[29]

People with cardiac disease "are at higher risk of death during extreme heat waves because the excess heat creates pressure on the cardiovascular system to cool the body."[30] Individuals who suffer from respiratory issues are also at a high risk of death "because heat waves are often accompanied by increases in air pollution and small particulate matter."[31] Therefore,

19. Kirn, *supra* note 12, at 40.
20. Carlson, *supra* note 1, at 213.
21. Kirn, *supra* note 12, at 40.
22. *Id.*
23. Hoffman et al., *supra* note 15, at 1.
24. *Id.* at 1–2.
25. Dexter H. Locke et al., *Residential Housing Segregation and Urban Tree Canopy in 37 U.S. Cities*, SocArXiv, 6 (Jan. 2020).
26. *Climate Change and Public Health*, World Health Organization (Feb. 3, 2021), https://perma.cc/2V2H-MK4Z.
27. *Id.*
28. Carlson, *supra* note 1, at 175.
29. *Id.*
30. *Id.*
31. *Id*.

anything that can mitigate the effects of extreme heat should be implemented. The consequences averted by measures taken to mitigate extreme heat would benefit everyone, but especially those with chronic health conditions.

While most studies focus on the difference in temperatures between the urban area compared to the neighboring rural or suburban area, there are important distinctions within the urban area.[32] Within a single urban area, the "urban heat island effect can cause temperatures to vary as much as 10°C [~18°F]."[33] Also, "[e]merging research suggests that many of the hottest urban areas also tend to be inhabited by resource-limited residents and communities of color, underscoring the emerging lens of environmental justice as it relates to urban climate change and adaptation."[34] Therefore, urban heat is an issue that is most pronounced for certain areas and individuals. The next section looks into the reasons there are temperature disparities within urban areas.

B. TREE CANOPY

Disparities in tree canopy is an environmental justice issue. The urban heat island effect varies even within cities. That is because concrete and green space are not distributed evenly across an urban area. This can create micro heat islands within a city. These heat patterns are likely the result of more concrete and fewer trees and green spaces. Studies have found that formerly redlined communities are hotter than other areas of the same city, with a disproportionate number of people of color living in those formerly redlined communities today.[35] Redlining was the practice of rating neighborhoods to help mortgage lenders determine which areas of a city were considered risky.[36] As one scholar notes, "affluent people 'buy' more favorable microclimates."[37]

Under redlining, the color red was used for neighborhoods deemed a lending risk, determined by the number of African Americans and immigrants living there.[38] Green was used for neighborhoods considered the safest, which contained mostly white residents. Even though the practice of redlining was banned in 1968, neighborhoods labeled red remain predominately low-to-moderate income and communities of

32. Hoffman et al., *supra* note 15, at 2.
33. *Id*.
34. *Id.*
35. *Id*. at 6.
36. *Id.* at 2.
37. Michael B. Gerrard, *Heat Waves: Legal Adaptation to the Most Lethal Climate Disaster (So Far)*, 40 UALR L. Rev. 515, 530 (2018).
38. *Id.*

color.[39] Those labeled green, or desirable, remain predominately above-average income and white.[40]

In a 2019 study of the 97 most populous U.S. cities, investigators used median household income and compared it to thermal satellite images to determine if there was a pattern between heat and income.[41] Low-income areas in the vast majority of those cities were more likely to be hotter than their wealthier counterparts.[42] Poorer areas were also disproportionately communities of color.[43] The study also found a dramatic increase in rates of emergency calls during dangerous heat waves given that heat makes chronic health conditions worse.[44] Low-income patients in the city's hot spots visited the hospital more often than low-income patients in cooler areas.[45]

Another study of 108 urban areas nationwide focused on the impact of redlining and temperature, the study found formerly redlined neighborhoods of nearly every city studied (94%) were hotter than the greenlined neighborhoods.[46] The average difference in temperature was 5°F.[47] The difference in one city was a nearly 13°F.[48] The authors attributed the heat difference to land use cover, especially the available tree canopy.[49] The authors conclude, "[t]he prevalence of impervious surfaces as opposed to tree canopy points to the fact that green spaces have been consistently more abundant in wealthier and majority White-identifying neighborhoods."[50]

Finally, in a study focused specifically on how redlining is related with present-day urban tree canopy, investigators studying 37 metropolitan areas across the U.S. found that redlining influenced the "location and allocation of trees and parks."[51] They found that formerly redlined neighborhoods have about half as many trees on average today (23%) as the highest-rated predominately white neighborhoods (43%).[52] Denser, formerly redlined communities have less available space for trees and tree

39. Gerrard, *supra* note 37, at 2.
40. *Id.*
41. Anderson & McMinn, *supra* note 5.
42. *Id.*
43. *Id*.
44. *Id.*
45. *Id.*
46. Hoffman et al., *supra* note 15, at 2, 6.
47. *Id.* at 2.
48. *Id.* The city was Portland, Oregon.
49. Hoffman et al., *supra* note 15, at 2.
50. *Id.* at 10.
51. Locke et al., *supra* note 25, at 6.
52. *Id.*

planting, while the formerly greenlined areas, " . . . comprised of single-family homes on larger lots could maintain, grow, and plant additional trees."[53]

These studies provide ample justification for cities to prioritize tree planting in low-income neighborhoods. Not only do those who live in cities experience hotter temperatures because of the built environment, but also low-income individuals in those cities bear the brunt of it. This is primarily due to the lack of tree canopy. While those who are wealthier can afford to plant trees on their larger properties and care for them, low-income individuals may not have the money to do so or the space. Cities must consider the legacy of development or lack thereof in certain areas, and how benefits have historically been distributed. Afterall, "[t]he urban poor, already often in hotter environments and already at higher risk for health problems, will have a harder time escaping climate change."[54]

II. CITY INITIATIVES TO INCREASE TREE CANOPY

Many cities across the U.S. have plans in place to plant more trees. These plans, however, vary. Some cities focus on providing free trees to private individuals to plant and maintain on their private property.[55] Other cities plant street trees and take responsibility for tree maintenance.[56] While others plant street trees and provide them to private individuals but ask those individuals to water them for a certain number of years.[57] In this section, I will highlight the differences between these initiatives and how they impact low-income communities. I will also discuss the issues with California's Urban Forest Project Protocol greenhouse gas emissions offset program.

A. LOS ANGELES

Los Angeles ("LA") is a good example of unequal tree distribution. For example, the tree canopy in the low-income area of South Los Angeles is about 10 percent compared to very wealthy Bel Air where the tree canopy

53. Locke et al., *supra* note 25, at 6.

54. Anderson & McMinn, *supra* note 5.

55. Greening Milwaukee, *Keep Greater Milwaukee Beautiful*,. https://perma.cc/UV83-G2HE.

56. Friends of the Urban Forest. New City Tree Care Policy, https://perma.cc/UF6Z-PFD2.

57. E. Gregory McPherson, *Monitoring Million Trees LA: Tree Performance During the Early Years and Future Benefits*, 40 ARBORICULTURE & URB. FORESTRY 285, 286 (2014).

is 53 percent.[58] One of the shadiest neighborhoods in LA is Hancock Park, "a luxury neighborhood in the flats with double-size lots and underground utility lines, where developers planted trees in the wide parkways and arranged for homeowners to pay extra maintenance fees."[59] Thus, in LA, tree canopy distribution was primarily determined by individual land owners who could pay for the luxury. The City's forestry department, however, would plant trees in parkways but only if petitioned by 75 percent of the property owners on a block. The legal owner of the property had to petition, not the tenants, and absentee landlords rarely bothered.[60] Those who are low-income are more likely to be renters than homeowners and thus have not historically had the same access to trees.

Los Angeles began to increase its tree canopy in 2006 after its Mayor announced an initiative to plant one million street trees.[61] Through this program, the city planted just over 400,000 trees throughout the city in seven years.[62] The program prioritized street, park, and yard tree planting projects.[63] "Street and yard tree planting projects occur in residential areas when trees are 'adopted' by locals who agree to maintain the trees planted on their property or along the street."[64] While the program did target areas with the least amount of tree canopy, the requirement that individuals maintain them may have been a challenge to low-income individuals.[65]

The current Mayor of LA, Eric Garcetti, has pledged to reduce the city's temperature by three degrees by 2050.[66] Part of the plan includes planting 90,000 trees in two years through its City Plants program.[67] The City is taking this goal very seriously, even creating the city's first Forest Officer position.[68] The goal is to increase the tree canopy by at least 50 percent in low-income areas by 2028.[69] Although there is some public planting, the City mostly donates trees to private citizens, who are responsible for maintenance.[70] The problem is that public plantings on the

58. Bloch, *supra* note 7.
59. *Id.*
60. *Id*.
61. *Id.*
62. McPherson, *supra* note 57, at 285.
63. *Id.* at 286.
64. *Id.*
65. The Times Editorial Board, *L.A.'s million trees, more or less*, L.A. TIMES (Apr. 23, 2013), https://perma.cc/Q9FF-944R.
66. Bloch, *supra* note 7.
67. Sharon Boorstin, *L.A. plans to plant 90,000 trees in two years. What can we learn from its oldest trees*? L.A. TIMES (Nov. 22, 2019), https://perma.cc/68GR-98AT.
68. Boorstin, *supra* note 67.
69. *Id.*
70. Bloch, *supra* note 7.

public right-of-way may not be feasible because low-income areas tend to have narrow sidewalks, underground water mains and overhead powerlines.[71] Therefore, for renters in apartment complexes in low-income areas, unless their landlord has planted trees on the property, trees may not be planted in their neighborhoods. This parallels Milwaukee's Adopt-A-Tree initiative where 89% of participants in the tree campaign were homeowners, while the rentership in the city was 55%.[72] Thus, for renters, the only accessible trees might be through planting street trees. But as indicated, the infrastructure of the city may pose a dilemma.

B. SAN FRANCISCO

San Francisco ("SF") is a good example of the need for government to take responsibility for the maintenance of street trees. The Trees for Tomorrow campaign began in 2005, resulting in over 25,000 trees planted in the span of eleven years.[73] In 2015, the San Francisco Board of Supervisors adopted the Urban Forest Plan to expand the number of street trees.[74] This was because, at the time, SF had one of the smallest tree canopies of any large U.S. city, and it was on the decline.[75] The reduction was because more trees were removed and died compared to new tree plantings.[76] The Urban Forest Plan recommended increasing the street tree population by 50,000 by 2034.[77] Another key recommendation was to fund a citywide street tree maintenance program.[78]

In 2012, the SF Mayor decided to shift the burden of maintenance of street trees and sidewalk damage caused by trees to private property owners because of the City's budget deficit.[79] As a result, many property owners decided to remove their trees because the cost of trimming a tree can be as high as $1,000.[80] The Urban Forest Plan indicates that the maintenance burden shift played a part in the declining tree canopy because the " . . . fragmented street tree maintenance structure makes achieving a

71. Bloch, *supra* note 7.

72. Irus Braverman, *Everybody Loves Trees: Policing American Cities through Street Trees*, 19 DUKE ENVTL. L. & POL'Y F 81, 91 (2008).

73. Noah Arroyo, *Proposition E: Returning Tree Maintenance to City Hall,* S.F. PUB. PRESS (Sept. 30, 2016). https://perma.cc/QE4M-B7DQ.

74. San Francisco Urban Forest Plan (Phase 1) Summary. https://perma.cc/S9L6-3GN9.

75. San Francisco Planning, Urban Forest Plan. https://perma.cc/MDH6-RSXP

76. *Id.*

77. San Francisco Planning, Urban Forest Plan Final Report, Fall 2014, https://perma.cc/7QYC-SKSZ.

78. *Id.*

79. Arroyo, *supra* note 73.

80. *Id.*

coordinated and standard level of tree care difficult to achieve."[81] After the shift, forty percent of street trees remained the responsibility of the City and 60 percent fell on private property owners and other public agencies.[82] This created confusion among property owners as to who was responsible for the trees in front of their homes, with many trees lacking maintenance and dying as a result.[83]

In 2016, 79 percent of the voters approved Proposition E, shifting the burden of maintenance of SF's 125,000 trees back to the City and setting aside $19 million to fund this project.[84] This project is known as StreetTreeSF and took effect July 2017.[85] Individual property owners can opt-out of the City's StreetTreeSF as long as they agree to maintain their trees and the sidewalks.[86] The program began by prioritizing trees that pose a safety hazard.[87] The City sets a schedule for street pruning based on blocks.[88] This schedule assures that trees are maintained properly and frequently so that they do not die and do not pose any safety hazards.

This model has shown success. The City is expanding the tree canopy and has taken responsibility for maintenance of trees. This assure that mature trees do not get removed by private property owners who do not want to bear the cost of maintenance. The monitored maintenance also reduces the risk of trees dying. Therefore, unlike LA, individuals may be more likely to identify areas for tree planting given that the City is providing a benefit at no cost to individual residents.

C. SAN DIEGO

The Global Warming Solutions Acts of 2006, commonly referred to as Assembly Bill 32 (AB 32), signed by the California Governor, set a statewide greenhouse gas emission reduction target of 1990 levels by 2020.[89] The same Governor signed an executive order establishing the reduction target of 80 percent below 1990 levels by 2050.[90] In accordance with AB 32, the California Air Resources Board ("CARB") adopted recommendations for local governments to create goals to reduce

81. San Francisco Urban Forest Plan Final Report, *supra* note 77, at 10.
82. *Id.*
83. *Id.*
84. Arroyo, *supra* note 73.
85. Friends of the Urban Forest, *supra* note 56.
86. San Francisco Launches New Voter-Backed Tree Maintenance Program, San Francisco Public Works, Press Release (July 1, 2017), https://perma.cc/MV47-UHNG.
87. StreetTreeSF, San Francisco Public Works, https://perma.cc/MU5P-TUT4.
88. *Id*.
89. City of San Diego, Climate Action Plan, Adopted Dec. 2015, at 3. https://perma.cc/UET6-SA38.
90. *Id.*

greenhouse gas emissions.[91] In December 2015, the city of San Diego adopted the Climate Action Plan, which established a plan to reduce its share of greenhouse gas emissions.[92]

The Climate Action Plan includes five strategies to achieve their emission reduction targets. One of these is climate resiliency.[93] Within the climate resiliency strategy, the only goal is to increase San Diego's urban tree canopy coverage to 15% by 2020 and 35% by 2035.[94] Consequently, the City adopted the Urban Forestry Program in 2017.[95] It is a five year plan that establishes the goals of planning, preservation, maintenance, and planting of trees to meet the targets set in the Climate Action Plan.[96] The plan identifies six areas where planting seems most feasible: (1) streets and parkways; (2) parks, community centers, schools, colleges, and other public properties; (3) state and federal properties; (4) residential properties; (5) commercial and industrial properties; and, (6) in canyons.[97]

Part of San Diego's plan includes the Free Tree SD initiative.[98] The city asks individuals to identify a space in the public right-of-way that could benefit from a tree.[99] If the city does plant the tree, the city asks the individual to water it for three years.[100] Similarly, the city also provides free trees for private property owner's parkways, but the property owner must also agree to water it for three years.[101]

San Diego provides a great example of how cities can increase their tree canopy. It is part of mitigation and adaptation to climate change and because it sequesters carbon, fits neatly into city plans that abide by AB 32. The plan, however, must prioritize areas that have minimal trees. This is essential in order to equalize benefits to communities that are severely lacking greenspace and are most vulnerable to extreme heat.

D. CALIFORNIA'S AB 32 URBAN FOREST PROJECT PROTOCOL

One potential method for cities to acquire funding for tree planting and maintenance could be by registering their urban forest with the CARB as an offset project. California's Urban Forest Project, "provides planners

91. *Id.*
92. City of San Diego, Climate Action Plan, *supra* note 89, at 3.
93. *Id*. at 23.
94. *Id.* at 41.
95. City of San Diego, Urban Forestry Program: Five Year Plan, Adopted Jan. 2017. https://perma.cc/QGY2-ESQA.
96. *Id.* at 16–19.
97. *Id.* at 20.
98. Free Tree SD, City of San Diego Website https://perma.cc/7E7H-SK58.
99. *Id.*
100. *Id.*
101. *Id*.

the unique opportunity to revitalize urban communities while making our urban ecosystems more resilient."[102] To achieve AB 32's goal of emissions reductions, major sources of GHG emissions are capped and must be reduced gradually. CARB is tasked with "adopt[ing] regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions."[103] Through this mandate, CARB developed the state's cap-and-trade program, which allows regulated sources to trade allowances and buy offset credits.[104] The offset program allows regulated entities to offset up to eight percent of their emissions obligations by purchasing carbon credits from approved projects that either avoid emitting GHGs or sequester GHGs.[105] One of these programs is the Urban Forest Project."[106]

Urban forests in the U.S. are estimated to store 918 million metric tons of carbon.[107] Annually, these trees produce a value of $5.4 billion to air pollution removal, $5.4 billion to reduced building energy use, $4.8 billion to carbon sequestration, and $2.7 billion to avoided pollutant emissions.[108] AB 32's Urban Forest Project provides offset credits and applies to projects on land owned or controlled by municipalities, utilities, or on education campuses.[109] Eligible project trees on municipality owned land must be planted "[a]long streets, in parks, city golf courses, cemeteries, near city buildings, greenbelts, city parking lots, and other public open space, or on private property."[110] For education campuses, trees must be planted "[a]long streets, near classrooms, dorms, office buildings, near recreational fields and other facilities, in parking lots, arboretums, and other open space on [c]ampuses."[111] For utilities, trees must be planted "[i]n parks, streets, parking lots, private property, and open spaces by utilities."[112] The credited GHG reductions and removal must be permanent; the carbon should remained stored for 100 years.[113] Furthermore, entities that want to register

102. Ellis Raskin, *Urban Forests as Weapons Against Climate Change: Lessons from California's Global Warming Solutions Act*, 47 THE URBAN LAWYER 387, 417 (2015).

103. *Id.*

104. Overview of ARB Emissions Trading Program (Feb. 9, 2015), https://perma.cc/D259-P4JX.

105. *Id*.

106. Cal. Air. Res. Bd., Compliance Offset Protocol: Urban Forest Projects (2011); Raskin, *supra* note 102, at 417.

107. David J. Nowak & Eric J. Greenfield, *Urban Forest Statistics, Values, and Projections*, 116 J. FORESTRY 164, 173 (2018).

108. *Id*. at 164.

109. Cal. Air. Res. Bd., Compliance Offset Protocol: Urban Forest Projects § 2.1 (2011).

110. *Id*. at § 4.

111. *Id*.

112. *Id*.

113. *Id*. at § 6.

their urban forest project under AB 32 must calculate the amount of carbon stored in their trees and subtract the carbon dioxide emission from vehicles travel and equipment related to tree planting, care, and monitoring.[114]

Based on the previous examples of cities expanding their urban forests, it would seem like the logical and most cost-effective way to maintain urban trees would be through registering them as an urban forest offset project. Nonetheless, the urban forest project has had no applicants because the protocol is deemed too complicated and burdensome to implement.[115] The requirement that the carbon be stored for 100 years is likely costly due to monitoring and tree replacement requirements.[116] Moreover, there is the risk that these projects will cost just as much as they would bring in and would add the stress of "possible liability repercussions if the project operator does not fulfill the protocol guidelines."[117] Additionally, the offset program does not require local emissions reductions. This means that a carbon emitting facility could buy urban forest offset credits from a city 5,000 miles away. This would overly burden the local community with the extra emissions and provide the benefit elsewhere. Ultimately, this has a detrimental effect on environmental justice communities.

As noted, there are fundamental issues with CARB's Urban Forest Project Protocol given that not a single municipality has registered their urban forest. To make the program more accessible, the project requirements must change. For now, California's cities and cities elsewhere must rely on other methods of increasing their tree canopy.

E. TREE INITIATIVE CONCLUSIONS

As these three different initiatives show, there are many different methods of implementing tree planting. The success of these initiatives depends on having the appropriate infrastructure and cities taking responsibility for tree maintenance. Through these initiatives, cities must prioritize low-income areas and tree deprived areas. Furthermore, they must take into account that renters do not have the ability to request a tree

114. *Id*. at § 4.

115. City Forest Credits, Tree Preservation Protocol – 40 Years, June 2019 at 45; Shannon Dulaney et al., Carbon Offsets and Health Co-Benefits: Assessing the Capacity of the Offset Program to Provide Health Co-benefits to California's Disadvantaged Communities, Yale University, at 24 (2017).

116. Joel Levin, Opportunities for Carbon Offsets from Urban Forestry Projects, Climate Action Reserve. https://perma.cc/ZNZ4-SQSW; Dulaney et al. *supra* note 115, at 25.

117. Dulaney et al. *supra* note 114, at 25.

for their property; the only option is requesting a street tree. Thus, cities must address this gap.

III. REGULATIONS AND INCENTIVES TO DISTRIBUTE TREE CANOPY MORE EQUALLY

One article notes that if 50 million urban trees were planted strategically to shade residential buildings and reduce air-conditioning energy use, they could offset emissions by an estimated 6.3 million tons of carbon dioxide annually.[118] This is about 3.6 percent of California's goal for carbon dioxide reduction.[119] Thus, it is imperative that cities take seriously the fact that climate change will impact their residents, but also that cities must do their part to mitigate climate change and provide measures that will allow the city to adapt to climate change.

Cities must prioritize areas where trees are lacking. Because urban forests are regulated through local ordinances, cities must be at the forefront of creating equity in the distribution of shade through trees.[120] This could be done through various regulations and incentives. While regulations may not be ideal, they are necessary. Furthermore, there are various models of incentives that are alluring to developers of residential units that would be necessary in order to provide shade to renters.

A. MANDATING TREES FOR NEW DEVELOPMENTS

Relying on property owners to increase tree planting around apartment complexes would likely not result in many new trees. As detailed in the previous section, cities with plans to expand their urban forest are limited in their plans because they are not reaching areas of the city where apartment complexes are the norm. The only area where cities can plant trees is in the public right-of-way. However, these trees may not provide enough shade to benefit the apartment complex, especially if they are big, multi-story complexes. Therefore, cities must require property owner and developers to include trees as part of a design plan.

In 2016, the City and County of San Francisco approved an ordinance that requires new residential and nonresidential rooftops to either have solar panels, living roofs or a combination of both.[121] Living Roofs are defined as "[t]he media for growing plants, as well as the set of related components

118. Jane Braxton Little, *The Future of Urban Forests in California's Cap & Trade Market*, 20 RELEAF 1, 9 (2012).

119. *Id.*

120. *Id.*

121. San Francisco Ordinance No. 221-16, § 4; San Francisco Planning Department, Better Roofs Webpage https://perma.cc/JK9N-3N6S.

installed exterior to a facility's roofing membrane. [It] includes both 'roof gardens' and 'landscaped roofs'."[122] Project developers opting for the living roof option must submit their plan to the City's Planning Department for approval.[123]

Following this model, cities could require tree planting as a requirement for new developments by approving a city ordinance. For residential units, the ordinance can require developers to implement into their design one tree for every five units. Alternatively, the number of trees can also be determined by square footage. The exact number of trees per unit or square footage should be determined by the needs of each city. Furthermore, these trees should be on private property and not in the public right-of-way. This will ensure more open space for tree coverage.

This could be a possible solution to the lack of trees. However, new development may not occur frequently in certain cities. Moreover, new development might only occur in areas that have plenty of trees and not in areas that lack tree canopy. Nonetheless, this requirement would still be important to adopt.

B. STORMWATER CREDITS AND DISCOUNTS FOR TREE PLANTING

Trees provide much more benefits than sequestering carbon and providing shade. They also reduce pollution, raise property values, and absorb rainfall.[124] The absorption of rainfall reduces runoff and thus lowers the cost of stormwater management.[125] A study conducted in the state of Indiana showed that street trees provide an economic benefit of $24.1 million annually to stormwater management.[126] Cities can tap into this benefit by providing stormwater credits or reductions to development or re-development projects that preserve and plant trees.

i. Stormwater Credits

Stormwater credits can be obtained by a developer in a development or re-development project for planting trees that collect and absorb stormwater runoff.[127] This credit is for stormwater the developer would otherwise be required to treat without the trees.[128] At the municipal level,

122. *Id.* at § 4(b).

123. San Francisco Ordinance No. 221-16, § 4(d).

124. Engineering Urban Forests for Stormwater Management, U.S. EPA, at 5 (Sept. 2013), https://perma.cc/NU63-SY7F.

125. *Id.*

126. *Id.*

127. Tree Credit Systems and Incentives at the Site Scale: Final Report, at 4 (Feb. 28, 2014), https://perma.cc/Z2XW-UVS3.

128. *Id.*

stormwater credits can be based on an individual tree basis for the runoff they prevent.[129]

For example, cities can provide a credit in reduction in the directly connected impervious area that must be treated on the site. Some municipalities grant 100-200 square feet reduction of the impervious area, depending on the tree, while others grant half the canopy area of existing trees.[130] Other municipalities, like Washington D.C., provide a credit for volume reduction of stormwater, rather than impervious area reduction.[131] It "provides a larger volume reduction for tree preservation (20 ft^3 per tree) than for newly planted trees (10 ft^3 per tree)."[132] Thus, D.C. policy places greater emphasis on maintaining older, mature trees that provide more benefits, as opposed to newer trees.

Municipalities that do not already have similar incentives in place could adopt them in order to increase tree canopy. This would potentially benefit low-income neighborhoods if apartment complex owners are re-developing a portion of the complex. Additionally, it is important that such policies provide a greater incentive for mature trees than newly planted ones because mature trees can capture more stormwater and sequester more carbon.

ii. Stormwater Fee Discounts

Another option is for cities to provide stormwater fee discounts. For example, the Philadelphia Water Department shifted fees from water consumed to fees based on impervious surface.[133] Homeowners pay a flat fee, while commercial and industrial customers pay based on impervious surface areas.[134] The Water Department "offers up to a 100% fee credit against impervious surface-based fees for the implementation of green infrastructure such as rain gardens, tree planting, rain barrels, wetlands and green roofs."[135]

If a city's water department charges property owners based on impervious surface area instead of consumption, then this policy could be implemented. A new version of this policy could impose the fee based on impervious surface to apartment complex owners if the owner is responsible for paying the water bill and not individual residents. This

129. *Id.* at 8.

130. Tree Credit Systems and Incentives at the Site Scale: Final Report, *supra* note 127, at 9.

131. *Id.* at 8.

132. *Id.*

133. *Id*. at 13.

134. *Id.*

135. *Id*.

would encourage apartment complex owners to install more trees in and around the apartment complex to reduce their water fee. However, it should be limited to trees or other greenery that cool buildings. There should also be specific guidelines on which types of trees qualify given that trees differ in the amount of stormwater they can capture.

C. PROVIDE DENSITY BONUSES FOR TREE PLANTING

Another incentive cities or states can adopt is density bonuses for residential development that is linked to tree canopy on the site of the development. This incentive can be modeled after California's Density Bonus Law.[136] A density bonus is "an increase in allowed dwelling units per acre, floor area ratio or height which generally means that more housing units can be built on any given site."[137] California's law allows developers in the state to receive a density bonus if they make a certain percentage of housing units restricted to low income residents.[138] The amount of density bonus depends on the percentage of units classified as very low income, low income, moderate income, and senior housing.[139] The project can also donate land to the city or county for very low income units in exchange for a density bonus.[140] For example, if the project restricts 5% of the units for very low income residents, then the project will get a 20% density bonus.[141] If the project restricts 10% of the units for low income residents, then the project also gets a 20% density bonus. The objective of the policy is to provide enough of an incentive for developers to include more affordable units.

Similarly, other states or cities that do not have a density bonus law could model their density bonus law on this one. A city can base density bonuses on the amount of new tree canopy that is incorporated in the new development. A policy could require developers to provide 15% tree canopy to get a 5% density bonus. If, however, a state, like California, already has a density bonus law, then the state can add trees to the already existing law. For example, California can require 5% of the units to be very low-income units and plant 5% new tree canopy in order to get the 20% density bonus. We would not want to discourage developers from

136. Codified at Cal. Gov. Code § 65915 – 65918.

137. Grounded Solutions Network, Inclusionary Housing webpage https://perma.cc/5APG-PHR8.

138. Cal. Gov. Code § 65915

139. *Id.*

140. *Id.*

141. Jon Goetz and Tom Sakai, *Guide to the California Density Bonus Law*, at 4 (Revised Jan. 2020), https://perma.cc/6C5R-ENDB.

providing affordable units, therefore, the amount of new tree canopy would need to be just enough to make the incentive alluring.

D. INCENTIVES FOR PLANTING TREES IN ALREADY EXISTING APARTMENT BUILDINGS

The previous regulations and incentives may only benefit new developments and those may very well be located in already tree rich areas. Therefore, cities must create incentives for owners of already existing apartment complexes to plant trees within or around the complex. For cities in California, this could be part of municipal plans that comply with AB 32, much like San Diego. Singapore provides a great model of for such an incentive program.

Singapore is one of the greenest countries in the world.[142] In 1968, the government declared transforming Singapore into a garden city, a clean and green city, its objective.[143] The government promoted various campaigns to plant trees and vegetation; those campaigns eventually became law and policy.[144] One of these is an incentive program that funds up to 50% of installation costs of rooftop and vertical greenery in order to replace green space lost on the ground.[145] The objective of the program is to encourage greenery in already existing buildings and bring environmental benefits to the neighborhood.[146] Eligible buildings include those that already exist and are occupied at the time of application or undergoing additions and alterations works.[147]

Providing partial funds to already occupied buildings will encourage owners to apply for such funding. These funds should be tailored to the needs of each city. Thus, in cities where high rises are not the norm, funds should be allocated to tree planting and not rooftop gardens. The funding will be alluring to owners of apartment complexes not only because it beautifies the area but also because greenery increases property value.[148] Furthermore, funding should prioritize shade-poor areas of urban cities over areas that already have ample trees and shade. Therefore, setting aside

142. Amy Kolczak, *This City Aims to Be the World's Greenest*, NATIONAL GEOGRAPHIC (Feb. 28, 2017), https://perma.cc/W8U7-AVRM.

143. Lye Lin Heng, *A Fine City in a Garden – Environmental Law and Governance*, SINGAPORE JOURNAL OF LEGAL STUDIES, at 104 (2008).

144. Joseph Chun, *Enhancing the Garden City: Toward a Deeper Shade of Green*, 18 SACLJ 248, 253 (2006); Parks and Trees Act (Chapter 216).

145. National Parks, Skyrise Greenery, https://perma.cc/6PMY-5SG6; Kolczak, *supra* note 142.

146. National Parks, *supra* note 145.

147. *Id.*

148. Raskin, *supra* note 102, at 417.

seventy-five percent of funding for shade-poor areas and twenty-five percent for all others would be ideal.

E. WHICH TREES SHOULD BE PLANTED?

With all these regulations and incentives, cities must include guidelines on which trees are proper and qualify for the incentive. This will definitely vary from city to city. The trees included for each city must "have (i) the best chance for survival in an uncertain future, and (ii) provide the greatest number of benefits and resources to local communities."[149] In drought prone areas, and really anywhere, a third requirement should be that the tree not require too much water.[150]

149. Raskin, *supra* note 102, at 409.
150. *Id.* at 412.

CONCLUSIONS

Increasing tree canopy and providing shade is one method for cities to combat climate change and its detrimental effects. As elucidated throughout this paper, climate change will result in more frequent and longer-lasting extreme heat days, which in turn will have a more drastic impact on low-income communities in urban areas than in their wealthier counterparts in the same city. Not only are low-income communities hotter by design, but shade is also a luxury that is difficult to find in low-income neighborhoods. While cities have taken initiatives to increase their tree canopy, some of these initiatives fall short for neighborhoods that would benefit most from trees. Nonetheless, these imperfect tree planting initiatives should continue to grow but city staff should attempt to reach low-income, shade-poor neighborhoods. For these initiatives to reach those neighborhoods, the city must take responsibility for maintenance and must prioritize neighborhoods with lower than average tree canopy.

Additionally, municipalities can adopt ordinances that require new developments to plant trees for a certain number of units or per square footage. This would be at the discretion of each municipality. If mandating trees seems too burdensome, cities can provide incentives to developers or owners of already existing buildings. These incentives can come in the form of stormwater credits or fee discounts, density bonuses for new developments, or providing funds to apartment complex owners who want to add trees to their already existing and occupied building. Furthermore, cities should continue to expand their urban forest programs and take responsibility for maintenance of trees in the public right-of-way.

Environmental justice and the ongoing consequences of climate change requires that cities evaluate the way their cities serve (or do not) their most vulnerable residents. One method is outlined throughout this note. To borrow from the father of environmental justice, Dr. Robert Bullard, "[o]ur elected officials need to understand our laws and need to apply them equally across the board. No community should be seen as compatible with pollution and poison."[151] Similarly here, as I have tried to demonstrate, cities must prioritize those neighborhoods that they have neglected and provide ample shade and greenery.

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151. Oliver Milman. *Robert Bullard: 'Environmental justice isn't just slang, it's real.'* THE GUARDIAN (Dec. 20, 2018), https://perma.cc/84XN-TVX2.