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Stepping Towards Sustainability: Analyzing Walkability in Urban Environments

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This paper examines path walkability in the urban environment and its various impact levels on different neighborhoods. One of the most accessible forms of sustainability is walking, as it produces zero carbon emissions and can harvest a greater sense of care for the human environment. In a growing urbanized world, providing citizens easy access to clean and safe sidewalks, parks, grocery stores, local restaurants, and religious organizations is essential. Accessible walking routes are vital in large, urban cities. The first chapter analyzes the need for walkable cities concerning ecosystem services and their functions. A brief history of New York's urban planning is mentioned in the next part of the chapter. Green areas are significant in promoting walking in cities, fulfilling ecological and recreational functions, and making more aesthetic communities. Walkable neighborhoods in urban areas can be socioeconomically or racially discriminatory. As explored in chapter two, environmental justice exists in commutes to work, food sources, and religious organizations. The third chapter discusses how new infrastructure, like newly paved sidewalks, crosswalks, and landscaping elements, can implore neighborhood residents to walk and shop more in their neighborhoods. In the fourth chapter, the political policies and economics of building greener areas and how increased walking can boost the community's economic standing will be brought forth. The fifth chapter provides how New York City achieved its high walkability and the importance of obtaining walkability in all cities.

Key Words: *Walkability, infrastructure, equitable, economics, sustainability, urbanized, transportation, environmental justice, urban environment*

According to IBISWorld, nearly 83% of the United States population lives in urban areas, defined by the United States Bureau as non-interrupted built areas with a population of at least 50,000, which contain about one or more central places like suburbs or urban fringes. With the high population in metropolitan cities, governments and local citizens need to make strides in

finding solutions to make their cities more green and environmentally friendly. Walking is one of the most overlooked solutions for creating more sustainable cities for people and the surrounding natural areas. According to the United Nations, roughly 70% of the greenhouse gases are caused by cities. Walking emits zero pollution and promotes physical and mental health, cohesive communities, economic gain, reduced traffic congestion, and pollution-emitting transportation. There have been some positive strides in making urban areas more walkable, like improved pedestrian infrastructure, which includes: Bike paths, newly constructed sidewalks, implementation of public green spaces, and affordable grocery shopping. Public policy and governmental intervention have limited the capacity of city planners and environmental activists because of capitalism and high levels of resource use, waste, pollution, and poverty.

A walkable city attracts businesses and encourages entrepreneurship by creating a conducive environment for small, local enterprises to thrive. As pedestrians move through urban areas on foot, they are more likely to discover and patronize local shops, cafes, and boutiques, stimulating the local economy. Moreover, walkability reduces the reliance on car-centric infrastructure, freeing up valuable urban space for mixed-use development, parks, and public plazas, which can serve as catalysts for economic activity and cultural enrichment. Additionally, improved walkability enhances the overall quality of life, making cities more attractive to residents and visitors. This, in turn, can lead to increased property values, higher demand for housing, and a rise in tourism, all of which contribute to a healthier urban economy. Investing in walkability is not just about creating pleasant streets; it is a strategic investment in urban centers' economic vitality and sustainability.

What can change how cities operate efficiently in an ever-growing world? How do we shift vehicle-dominant streets to pedestrian-dominate, change parking lots to parks, and create

local businesses to promote economic incentives? We can look at introducing policies that promote mixed land-use development, where residential, commercial, and recreational spaces coexist, reduce the need for long commutes, and make essential amenities more accessible by foot. Embracing green urban planning practices, such as planting trees and creating green spaces, not only enhances the aesthetic appeal of a city but also improves air quality and offers pleasant pathways for pedestrians. Fostering a walking culture through public awareness campaigns, safety initiatives, and community engagement can encourage residents to choose walking as a preferred mode of transportation, ultimately transforming unwalkable cities into pedestrian-friendly, livable urban centers.

We will delve into the intricate web of factors that shape walkable cities through dedicated chapters focused on sustainability, environmental justice, governmental intervention, and public policy—uncovering the symbiotic relationship between walkability and sustainability. While making clear the profound implications of walkability on environmental justice and dissecting the role of governmental intervention in shaping pedestrian-friendly urban spaces, This will then help examine the effectiveness of public policies in fostering walkable communities and show the need to call to action governmental leaders of large metropolitan areas to invest more in pedestrian infrastructure, implement complete street policies, provide shade and green regions, and endorse pedestrian safety knowledge. By addressing these multifaceted aspects of walkability, I aspire to contribute to the academic discourse and the transformation of cities worldwide, where each step taken is a stride towards a more inclusive, healthier, and environmentally conscious urban future.

Chapter 1: Ecosystem Services through Walkability and the History of New York City's Urban Planning

In this chapter, I explore how the strategic design of cities for walkability can yield numerous advantages for the built environment, neighboring communities, wildlife, and climate regulation. To gain deeper insights into the detrimental effects of limited pedestrian areas in urban settings on both the planet and human populations, a thorough examination of their causes and consequences must be taken. Despite the pressing need for efficient transportation solutions in densely populated cities, prioritizing walking often needs to be recognized in urban development initiatives. This could be in part due to modernizing infrastructure like subways, light rails, and electric cars, or, arguably, because humanity has become increasingly lazy in their commutes due to things like Uber, Lyft, and remote work that became the new norm after the COVID-19 pandemic. This chapter will also briefly look into the urban planning history of New York City, as this paper looks at two different neighborhoods in Manhattan to glean the development of the largest city in America.

Ecosystem Services in Walkability

Ecosystem services are nature's invaluable benefits to humans and the environment. These services encompass various essential contributions from natural ecosystems, from providing food, clean water, and raw materials to regulating climate, pollinating crops, and air and water purification. Ecosystems also offer cultural and recreational value, enriching citizens' lives through aesthetics and leisure opportunities. These services help our planet by supporting soil formation, nutrient cycling, and biodiversity maintenance, enabling the sustainability of all other services. Understanding and safeguarding ecosystem services is necessary to promote a

harmonious coexistence between human societies and the natural world, foster environmental resilience, and ensure the well-being of both present and future generations.

Walking has many benefits to human life, but mainly for physical health. Significant research has been done that shows the correlation between walking and reduced air pollution and health risks. “Physical inactivity and outdoor urban air pollution are two of the top 15 global causes of health impairment” (Ezzati et al., 2002; Hill et al., 2003). The research shows that harmful gasses emitted from motor vehicles, like ozone, particulate matter, and carbon monoxide, can significantly decrease the health of humans who breathe in this air. This health effect finding is important because “in polluted U.S. cities, the mortality risk from particulate air pollution is comparable to that for obesity” (Pope III, 2002). Curbing the rates of outdoor air pollution is essential when building a walkable city, as clean air is vital in an enjoyable outdoor walk, with rising health risks, such as respiratory illnesses and an increase in smoke-related activities. When creating walkable cities, urban planners must understand the importance of ecosystem factors that will create cleaner air. One way that urban planners can incorporate natural ambiance in cities is through the use of trees. “Trees absorb CO2 and gaseous pollutants such as O3, NO2, SO2 primarily by uptake via leaf stomata or surface, and accumulate airborne particulates (by interception, impaction or sedimentation) more effectively than other urban surfaces” (Salmond et al., 2016). By utilizing trees to 1) reduce the levels of harmful pollutants and 2) create a better walking environment, citizens living in high-density areas will have more of an inclination to walk to their desired destinations but also be less susceptible to dangerous health risks.

Now, it is essential to understand that public modes of transportation are still needed in urban areas to help all people get from place to place, as they also aid with reducing the number

of cars in the city and lower the consumption of things like gas. Because air pollution and physical inactivity are closely intertwined, it is necessary to find solutions to make walking safe in large cities with high-emitting infrastructure. Walkable cities encourage people to use their legs instead of cars, reducing reliance on fossil fuels and decreasing air pollution. This improvement in air quality is an ecosystem service provided by investing in clean energy transportation, reducing the use of cars, and improving sidewalks to make it easier for people to walk to their required places. If streets were used less for motorized vehicles and more for walking spaces, it could significantly filter out pollutants in the air. One study (Brand et al., 2021) found that "shifting to active transport could save as much as a quarter of personal carbon dioxide (CO2) emissions from transportation." This is a significant result as it shows the critical connection between humans and reducing unhealthy air quality in their neighborhoods.

One of the main things walkable cities emphasize is using green areas and architecture to help reduce pollution and manage many other ecosystem services. Walkable cities often incorporate green infrastructure elements such as parks, urban forests, and green corridors. These elements provide ecosystem services such as improved air and water quality, temperature regulation, and habitat for wildlife. One thing cities help diminish is the use of grass lawns and the use of grass as a means of being "greener." However, some studies have found that there is a "biodiversity loss due to the development of monoculture lawns of a few grass species as well as environmental pollution from excessive use of fertilizers, pesticides, herbicides, irrigation, and gasoline global warming concerns due to greenhouse gas (e.g., nitrous oxide) emissions from fertilizers and frequent mowing" (Paudel et al., 2023). Lawns are not required when thinking of greenspaces, instead urban planners should look for opportunities to provide meadowscapes which are "open habitats or fields, created and managed by humans within urban and suburban

landscapes" (Paudel et al., 2023). These offer many benefits like "visual aesthetics (Ignatieva et al., 2018), health benefits from opportunities for physical activity and recreation (Lai et al., 2019), urban heat regulation, flood and pollution control, soil stability and improvement, erosion control, more comprehensive landscape visibility, and carbon storage" (Beard et al., 1994, Erickson et al., 2001, Milesi et al., 2005, Thompson et. al, 2017). Not only would green spaces, including parks and walking trails, promote physical activity, but they would also support urban biodiversity. These green areas serve as habitats for various species, promoting urban ecology. Biodiversity, in turn, provides ecosystem services like pollination of plants and pest control. Green cities also use sustainable porous surfaces like sidewalks with permeable pavers and green alleys. These help manage stormwater runoff by allowing rainwater to infiltrate the ground, reducing the risk of flooding. Proper stormwater management is an ecosystem service that mimics natural hydrological processes.

Another way that walking can help create more sustainable cities is by reducing the urban heat island effect, which is "when cities replace natural land cover with dense concentrations of pavement, buildings, and other surfaces that absorb and retain heat. This effect increases energy costs (e.g., for air conditioning), air pollution levels, and heat-related illness and mortality" (*How Walkable Cities Can Curb Urban Heat Islands*, 2022). In large cities, especially New York, the heat island effect usually occurs due to heat-absorbing infrastructure, such as black asphalt concrete, and materials, such as steel, in buildings. According to the Environmental Protection Agency (EPA), "The annual mean air temperature of a city with 1 million people or more can be 1.8–5.4°F warmer than its surroundings. In the evening, the difference can be as high as 22°F " (US Environmental Protection Agency, 2014). The increasing temperatures shown by the EPA, especially in warmer seasons and climates, increase air conditioning costs, greenhouse gas

emissions, and energy demand. For people, it can cause heat stroke, uncomfortable walking conditions, and exacerbate pre-existing illness. By reconstructing large cities to be more walkable, cities can also reduce the heat island effect and the overall global warming caused by climate change. When city planners develop new walkways and building designs, they can use materials that absorb less heat. One opinion on mitigating the urban heat island effect is to create buildings made of sustainable materials like green roofs, solar panels, and green facades, which absorb heat through evapotranspiration. This process is reflected through plants' natural ability to take water from the soil or groundwater and release it into the atmosphere. Through this ability, green building concepts lower ambient and indoor temperatures through their cooling effects. Both green walls and green facades "act as an extra thermal insulator on the building wall, which would lessen the need for electric heating and cooling" (Cairns and Young, 2017). Incorporating vegetation on city buildings, like green roofs and green facades, would act as an ecosystem service through the natural function of plant processes and sustainable cooling systems.

Another sustainable technology would be solar panels, as they convert sunlight into energy, reduce electricity costs, and use free natural resources. New York City aims to produce 1000 MW of solar technology citywide by 2030. So far, the city has been able to increase that capacity "between 2013 and 2016, from 25 megawatts (MW) to 92 MW in 2016"(*Zoning for Solar*, 2022). While this is not near the intended goal, it shows an effort to reach that 2030 goal. The need for more solar energy is evident in that "solar panels reduce the energy needed for air-conditioning (by 12%) and also the Urban Heat Island (UHI): 0.2 K by day and up to 0.3 K at night" (Masson et al. 2014). By using the ecosystem service of sunlight, cities could reduce temperature and reduce electricity. As (Enteria et al., 2020) state in their book, "urban areas are

expected to minimize the build-up of heat, pollution, and the utilization of different urban greening technologies, which can contribute to the minimization of UHI."

Walkability in urban cities is a vital component of urban planning that intersects with various ecosystem services. By promoting walkability, cities can enhance the well-being of their residents, reduce environmental impacts, and create more sustainable and resilient urban ecosystems. This approach contributes to the overall livability and health of urban areas while recognizing the value of nature in supporting these goals. By implementing these three ecosystem strategies, 1) reducing air pollution, 2) creating natural green areas, and 3) using green sustainable materials for building cities like New York, we can strive for a more walkable environment.

The History of Urban Planning in NYC

New York City boasts a rich and dynamic urban planning history that has profoundly shaped its iconic skyline and urban fabric. At the heart of this history lies a complex interplay of factors, including population growth, economic development, transportation infrastructure, and an enduring commitment to fostering walkability and public spaces.

From Manhattan's beginning, it had always been a main port for trading and other business ventures. Because of its location, it is adjacent to both the East and Hudson Rivers, which feed into a giant port near the Atlantic Ocean. The geographic location of Manhattan allowed for it to boom in most climates of American history. For example, New York City was "only the third largest American port at the time of the American Revolution. New York gradually achieved trade domination and, by the mid-1800s, handled more than half of the country's oceangoing travelers and commercial trade" (Lankevich, 2023). Because of this easy access to America's first large city, population growth grew exponentially, and city officials

quickly developed plans to make the city more pedestrian-friendly. With this, the commission plan of 1811 in Manhattan created the idea of the grid system. “the grid laid out 155 east-west streets and 12 north-south avenues and stopped at 155th Street due to challenging ground conditions further north and since at the time there was no need for further development” (Hoffman, 2013). This instilled the ease of walkability in New York City from a very early stage and also set up accessible subway and bus stations along avenues and easily definable streets.

New York has five different boroughs: Manhattan, Brooklyn, the Bronx, Staten Island, and Queens– with each borough having other neighborhoods. The subway system, inaugurated in 1904, became a lifeline connecting diverse communities and boroughs. Post-Civil War “Manhattan had most of the lines and service,” whereas “elevated lines were simply replaced by subway lines decades later, such as the line that ran north into the Bronx and terminated at Bronx Park, now home to the Bronx Zoo” (King, 2011). This difference in subway availability, early on, shows how Manhattan’s population, especially what is now the Lower East Side and the Financial District, was more centralized there. The Bronx and Brooklyn were more rural and less populated. With the creation of subway lines, the vertical shift grew to skyscrapers and other transportation buildings like the Grand Concourse. The Grand Concourse was opened in 1909 and built by Louis Aloys Risse. It was supposed to mimic the Champs-Élysées in Paris. The Grand Concourse is located from E 138th Street to E 206th, which the Mosholou Parkway now dominates, and when it was first established, it represented “the “Park Avenue of the middle class” (Chan, 2009). This shows how, through the years, the Bronx would be one of the primary victims of failing urban planning and many environmental justice issues.

Today, many of the most walkable neighborhoods are still where Manhattan planted its urban roots. Areas like the Lower East Side, SoHo, Tribeca, and Greenwich Village are some of

the most walkable communities in the country, mainly because they were primarily developed before automobiles. As the rise of cars became rampant and a higher population of commuters dawned, the streets in Manhattan and the surrounding boroughs quickly turned into car-centric rather than pedestrian-friendly neighborhoods. Although the Bronx has more green space than any other borough in New York City, with "24% considered parkland, environmentalists say that much of its green space is consolidated in large parks on the periphery of the borough, which are difficult to access for many residents" (Sequeira, 2022). This data proves there is still a need for greater accessibility to green spaces in Manhattan and to ensure all citizens receive that access equally.

New York City's urban planning history is a testament to the enduring value of walkability in a metropolis known for its energy and vibrancy. From the grid system to the preservation of green spaces and the evolution of public transportation, the city's commitment to fostering walkable neighborhoods remains at the heart of its urban planning efforts. The "New Urbanism" logic has become more centered on developing cities, and it mainly refers to building human-scale environments that are primarily for the use of pedestrian activities such as walking, biking, and public transportation. In short, New Urbanism is "the revival of our lost art of place-making, and is essentially a re-ordering of the built environment into the form of complete cities, towns, villages, and neighborhoods - the way communities have been built for centuries around the world" (*New Urbanism*, 2019). In the upcoming chapters, I will focus on walkability and how it correlates to environmental justice, Manhattan's economy, political involvement, and steps to improve in the future.

Chapter Two: Bridging the Gap: Environmental Justice and Walkability in NYC

Environmental Justice in Urban Landscapes

In some neighborhoods, the lack of walkability contrasts with more pedestrian-friendly counterparts, leading to significant health disparities. These areas often need more access to safe sidewalks, well-maintained public spaces, and community amenities, which hinder residents from engaging in physical activities like walking. The consequences of this disparity are profound, with elevated BMI levels and a higher prevalence of health problems, particularly cardiovascular issues, among residents in these less walkable neighborhoods. This problem contributes to the presence of highway systems that dissect communities, effectively creating barriers to safe pedestrian passage and leading to increased exposure to air pollution, noise, and other environmental stressors. Addressing these inequities by improving walkability and enhancing pedestrian infrastructure is essential for reducing health disparities and ensuring all communities have equal access to walkable neighborhoods' physical and mental health benefits. In America, roughly 40 percent of Americans are obese, and this is rapidly increasing. Several studies were conducted to determine how a lack of walkable neighborhoods promotes a sedentary lifestyle. Obesity can induce or exacerbate other health problems like diabetes and cardiovascular disease. Many studies conclude that “more affluent neighborhoods might, for instance, provide healthier food choices or more resources” (Rundle et al., 2008). This distinction is important because environmental disparities exist between neighborhoods, especially economically.

New York and several other states, cities, and towns are rated and evaluated to determine their walkability score. The ranking the NYC Environment and Health Department relies on is comprised of “residential population density (density of population per total residential land area), intersection density, an entropy measure of land use based on the distribution of building floor area among six land use types (education, entertainment, single-family residential,

multi-family residential, retail, and office), and retail floor area ratio, or the ratio of retail building floor area to retail land area" (Frank et al., 2005). Walkability Indexes allow residents to note their neighborhood or future neighborhood walkability, essential when determining where to live. They also show city and neighborhood differences related to physical activity. This index forgets one crucial aspect of neighborhood livability, as (Neckerman et al., 2009) point out that Walkable Index scores "cannot explain disparities in physical activity between poor and nonpoor neighborhoods within big-city environments." This recognition highlights the main concern addressed in this chapter: Environmental Justice.

Environmental Justice is seen in many forms and can have high stakes in marginalized communities due to government regulations, city planning, and zoning inefficiencies. Environmental justice concepts and definitions "highlight the differential exposure to environmental burdens and access to environmental goods experienced by different socioeconomic groups" (Kronenberg et al., 2020). This notion of EJ mirrors all cities and towns in the United States, where neighborhoods are isolated according to socioeconomic status. It is important to note that environmental justice does not cover environmental racism, which is essential to acknowledge when looking at neighborhoods, race makeup, socioeconomic status, mental health and wellness, and geographic location of toxic facilities and waste sites. "Health disparities relevant to environmental racism include asthma, cancer, and chemical poisoning, which is caused by disparities in exposure to air pollutants, lead, and toxicants" (Gee and Payne-Sturgers, 2004). Chronic illnesses result from the government placing vulnerable communities at risk by prioritizing economic profit over environmental health. Numerous EJ sites all over the United States show significant data on how governments, income, and racial inequality have left minority people with insufficient funding and inadequate access to parks,

electricity, and health risks when compared to white, affluent areas. Some examples of these sites are Cancer Alley in Louisiana, due to its abundance of petrochemical facilities in low-income neighborhoods, and Flint, Michigan's lead-contaminated water in an impoverished town. These sites are just two examples of high-profile cases, but these problems are happening everywhere, and governmental funding and intervention are required to negate these environmental hazards.

Additionally, a long history of housing inequities leaves people of color struggling to maintain a healthy, functional way of life. For example, "New York City's creation of zoning ordinances in 1916 allowed them to rezone neighborhoods, resulting in manufacturing zones concentrated in areas where Blacks resided" (Henderson et al., 2021). This takes us into the meat of how and why walkability scores only show a surface level of how walkable a neighborhood is. The complex interplay of walkability, public health, and environmental justice is a multifaceted challenge that necessitates comprehensive, equitable urban planning and policy efforts.

Environmental Injustices: Contrasts in the Upper West Side and South Bronx, NYC

This section will examine the walkability in two parts of New York City: the South Bronx and Upper West Side neighborhoods. The Upper West Side is situated near an oasis of trees, streams, biking and walking trails, and abundant green space. Central Park is surrounded by urban development, including the National History Museum, dining, and quiet, well-maintained neighborhoods. In the South Bronx, the Hunt's Point and Mott Haven neighborhoods are engulfed by freeways, waste facilities, and a large distribution center– The Hunt's Point Cooperative Market (the largest distribution center in America). However, the walkability index scores between these two areas are comparatively similar. According to the official walkability index site, the South Bronx scores a 94 out of 100 in walkability, and the Upper West Side scores a 98.

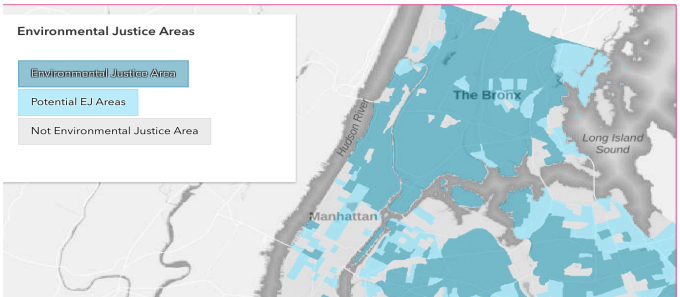
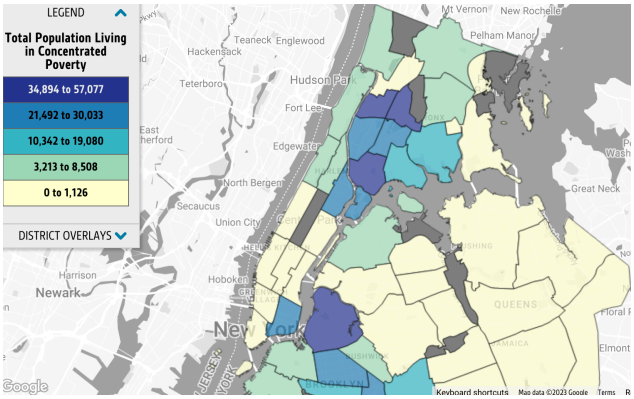


Figure 1: Environmental Justice Areas[1]

As noted in the last section, the walkability index does not consider the surrounding built-environment, racial demographics, and the socioeconomic level of the neighborhood. Instead, it is based on the distance to amenities. Demographics, health, and income must be examined to discover an objective perspective of the neighborhoods.

Figure 1. Shows a map made by NYC's Department of Climate and Justice that points out the areas defined as the "areas that have been and continue to be more vulnerable to potential environmental injustices due to factors including history of systemic racism and inequitable resource distribution" (NYCgov.com). This map points out how the South Bronx is determined to be an entire environmental injustice zone, whereas the Upper West Bronx is omitted. Environmental justice and environmental racism are pivotal factors in the decision-making processes that result in significant disparities between affluent and economically disadvantaged neighborhoods, leading to the unequal allocation of environmental burdens in impoverished communities. To show this significance, Figure 2. Reveals the concentration of people living in concentrated poverty in New York City. This is important because it offers a significant resemblance between the areas that experience environmental injustice and those that do not.



[1] "Environmental Justice." 2020. NYC Mayor's Office of Climate and Environmental Justice. 2020. https://climate.cityofnewyork.us/topic/environmental-justice/.

Figure 2. Concentration of Poverty[2]

Visually and through comparison between these maps, the difference in neighborhood demographics between the South Bronx and the Upper West Side supports the studies that conclude environmental injustices are more prevalent in areas of concentrated poverty. In the context of New York City, the most effective means of gauging proximity to parks is by conducting a street network analysis, given the city's unique urban layout and ground composition. This approach considers a reasonable, pedestrian-friendly distance, as walking remains the most universally accessible mode of transportation for city residents. Although alternative transportation methods are available, such as non-automobile options, walking stands out as a primary mode of transit. The impediments to walking in the city play a pivotal role in determining an individual's accessibility to parks, which is not shown in the Walkability Index Score. There needs to be a way that adequately ranks walkability in all neighborhoods to show how some neighborhoods are targeted in consequential environmental disasters like poor health, clean parks, and harmful facilities.

Health Disparities in the Upper West Side and South Bronx, NYC

In lower socioeconomic neighborhoods, the pervasive issue of obesity and the elevated incidence of asthma serve as alarming indicators of health disparities closely linked to environmental burdens. Residents of these underserved communities often contend with various environmental challenges, ranging from the presence of highways and limited access to green spaces to the adverse quality of available open spaces, an inadequate supply of healthy food resources, proximity to waste sites, and disparities in food distribution centers. These environmental factors collectively contribute to individuals' pronounced health challenges in

[2] "Concentrated Poverty." 2020. Data.cccnewyork.org. 2020. https://data.cccnewyork.org/data/map/1224/concentrated-poverty#1224/a/3/1386/99/a/a.

these areas. In this complex interplay of urban environments and public health, this chapter delves into the multifaceted relationship between environmental burdens and the concerning rates of obesity and asthma in lower socioeconomic neighborhoods, underscoring the pressing need for comprehensive solutions and equitable policies to mitigate these disparities.

The South Bronx holds “approximately 15 waste transfer stations, or about 24% of the city's total number of these stations,” where these waste transfer stations “handle over 31% of New York City’s solid waste… the South Bronx has about 6.5% of the City’s population” (South Bronx, 2009). The location of these waste transfer stations shows the environmental injustices that continue to hold South Bronx neighborhoods in a chokehold. These stations permit the transport of thousands of diesel trucks daily, emitting harmful particulate matter. Hunt’s Point is an isolated part of the city due to invasive, highly trafficked highways like the Bruckner Expressway, Major Deegan, and the Cross Bronx Expressway, which produce more commitments to the neighborhood. The residents in Hunt’s Point consistently have the highest childhood and adult asthma rates (Walters et al., 2021). Living in an environment with significant pollution, such as air pollution, creates or intensifies pre-existing health conditions. The link between socioeconomic status and unfavorable environments transforms into an association between socioeconomic status and compromised health.

A significant health disparity in the South Bronx, namely Hunt’s point, is the prevalence of asthma among all age groups. In fact, “In 2016, the asthma-related ED visit rate among Bronx children ages 5 to 17 years was more than two times the rate of all other NYC boroughs combined” (Walters et al. 2021). This disparity is due to the highly concentrated diesel truck streets and significant highways encompassing the South Bronx. In addition, “Bronx children are more likely to be exposed to household aeroallergens to which they are sensitized and have poor

housing conditions. Their parents are more likely to report low expectations for asthma control and high levels of psychological stress" (Warman, Silver, and Wood, 2009). Long lines of polluting trucks and waste facilities surround the Hunt's Point Market. These emissions, like particulate matter, are the leading causes of asthma and are a source of environmental injustice. The NYC government data shows the stark difference in asthma rates in the South Bronx and the Upper West Side to show the difference. In the South Bronx, 20% of its residents have asthma, compared to the Upper West Side, with 16.4% ("Asthma Data for NYC" 2020). This information shows the need to focus on neighborhoods like Hunt's Point and garden community participation to make an effort towards a more equitable and healthy city.

Regarding physical fitness, extensive research has explored the link between the constructed environment and excess weight and obesity, focusing on children. Within this context, the accessibility of parks assumes a pivotal role, as they serve as a primary avenue for urban residents to engage in physical activity. "Neighborhood-level access to large, but not small parks, is associated with lower Body Mass Index (BMI)" (Weiss et al., 2011). Low-income neighborhoods are characterized by a higher prevalence of smaller parks that often lack the natural spaces or trails conducive to walking and running. Consequently, the availability of park-based physical activity in New York City is a public health concern and an environmental justice issue.

The walkability of neighborhoods significantly influences residents' capacity to uphold their well-being, and the interconnection between neighborhood walkability and park accessibility is deeply ingrained in urban health and environmental justice. Environmental hazards act as formidable barriers, restricting individuals' access to parks. Communities with elevated concentrations of detrimental land use and heightened insecurity are particularly

susceptible to the adverse health consequences of diminished park access. In New York City, "over three times as many people died of diabetes in 2001 in lowest-income neighborhoods than those in highest-income neighborhoods"(Health Disparities, 2004). The relationship between higher obesity rates and minority communities in the United States is well established. Wang and Beydoun conducted a study of national obesity data between 1990 and 2006, finding that "those who classified themselves as non-Hispanic whites have a significantly lower risk of obesity at all ages and genders than people who classified themselves as Black or Mexican American" (Wang et al., 2007). Obesity and lower physical activity cause more health effects, reducing people's lives. Environmental inequalities stem from access to parks and recreation and toxic neighborhoods from utility and food access. These all contribute to the environmental injustices seen in major cities worldwide, shown in this section, New York City. There are 4.5 miles between the Upper West Side and the South Bronx, but each neighborhood has severe differences. The Upper West Side is a predominantly white, affluent neighborhood with relatively healthy residents and low amounts of noxious emissions. The South Bronx is a predominantly Hispanic or black neighborhood with concentrated poverty, and residents have high health risks. This is what Environmental injustices and systemic racism do to community environments—as shown in Table 3. Parkland in NYC has an obvious correlation to EJ neighborhoods and a lack of green spaces compared to affluent neighborhoods. Looking at the map, it is clear that the South Bronx offers minimal space for outdoor activities.

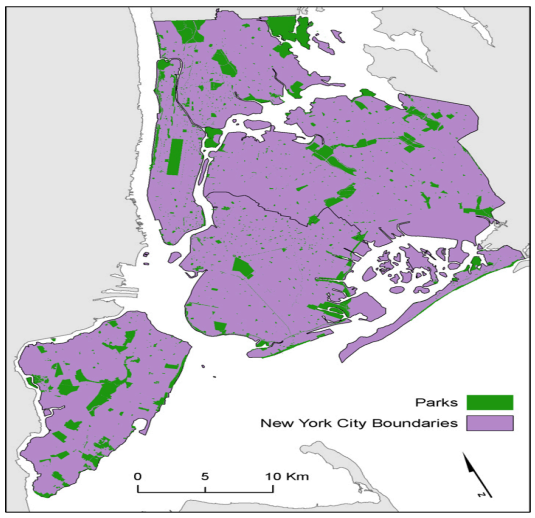


Fig. 3 Park Land in NYC[3]

Chapter Three: Navigating New York City: Walkability Infrastructure Insights

Urban Planners and Architects: How to Design a Walkable City

Environmental inequities in urban cities underscore the profound impact of systemic racism on the fabric of community environments, revealing the urgent need for holistic urban planning that prioritizes equitable access to green spaces and addresses the root causes of health disparities. When designing cities, it is crucial to factor in several components to create equitable, healthy neighborhoods. What exactly is green urban planning? Green urban planning is the creation of cities that allow for mixed land use, such as parks, community gardens, and accessible pathways. Green planning aims to maximize urban biodiversity by "greening urban rooftops and spaces assists in fighting the rise of urban heat islands - areas where temperatures exceed those of surrounding areas" (Enel X). Green planning also extends to how local resources are used, such as local food production, building materials and conforming cities to the surrounding nature, rather than exploiting the natural landscapes. Decentralizing energy distribution is also a task that is required for urban planners. This would allow the consumer to become the producer. There are many things an urban planner must consider when designing a green city. Figure 4. demonstrates a few more of the components that are necessary when planning.

[3] Miyake, Keith K., Andrew R. Maroko, Kristen L. Grady, Juliana A. Maantay, and Peter S. Arno. "Not Just a Walk in the Park: Methodological Improvements for Determining Environmental Justice Implications of Park Access in New York City for the Promotion of Physical Activity." Cities and the Environment. Vol. 3. 2010.

Figure 4: Green Urbanism Components[4]

Green spaces are crucial in shaping identity, preserving memories, and fostering a sense of belonging. Urban greenability can define the city's identity and influence neighboring districts to embrace a similar identity. A New York City sustainable walkable community report discusses the goals and strategies for creating green spaces in current neighborhoods. Specifically, this report highlights Arthur Avenue in Little Italy of the Bronx. Additionally, the report identifies New York City problem areas that must be addressed. The NYC Departments of Planning, Design and Construction, and Health and Mental Hygiene have created a zoning tool called an Enhanced Commercial District (EC District) to support building and maintaining well-designed urban street environments. The EC Districts "require future developments to provide more active retail uses occupying a minimum percentage of the ground floor, and require all parking to be beyond 30 feet of the street wall" (NYC.gov).

Additionally, "pedestrian impediments such as curb cuts for parking must be located on side streets, and minimum levels of ground floor level transparency are required" (NYC.gov). Introducing EC Districts allows customization to address specific challenges within evolving urban landscapes. The application of EC Districts along emerging retail corridors, such as Broadway in Bedford-Stuyvesant, demonstrates a proactive approach to urban development. By pairing EC District regulations with considerations for elevated rail lines, the city aims to accommodate the evolving needs of adjacent lots and ensure the provision of quality retail spaces for the growing population.

In the Upper West Side of Manhattan, where residential density and limited commercial space pose challenges, implementing two distinct EC Districts in 2012 addresses community

[4] "What Is Green Urbanism and What Are Its Principles." n.d. Enel X. https://corporate.enelx.com/en/question-and-answers/what-is-green-urbanism.

concerns about changes to the retail landscape. Customized regulations for Amsterdam and Columbus Avenues focus on maintaining diverse storefronts by establishing maximum frontage widths and minimum store counts per block. On Broadway, the rules target the regional character of commercial stores, explicitly addressing the proliferation of banks along the corridor. Minimum ground floor transparency requirements across all corridors contribute to preserving a rich urban fabric.

Fig. 5 Attributes to a Walkable Street[5]

Sidewalk infrastructure is constantly the most essential part of creating walkable cities. Sidewalks pose a link to public transportation, parks, retail, religious buildings, and residential areas— starting a boundary separating private development from the public right of way. A variety of elements are required to have well-maintained sidewalks. Streetlights are essential to sidewalk infrastructure as they offer safer, illuminated streets. Street trees are also needed to adorn sidewalks, which provides green proximity and natural cooling to the sidewalk walkers.

Reducing the width of streets and implementing traffic calming measures, such as speed bumps, chicanes, and raised crosswalks, can contribute to a safer and more walkable urban environment. These measures not only enhance pedestrian safety but also discourage excessive vehicle speed. These features also help pedestrians have a safe commute throughout the city.

[5] NYC, Gov. 2018. “STRATEGIES: Walkability 36 Arthur Avenue, the Bronx.” 2018. https://www.nyc.gov/assets/planning/download/pdf/plans-studies/sustainable-communities/bmn/bronx_metro_report/walkability.pdf.%20Accessed%2030%20November%202023.

Clear signage and navigational intuitiveness must be implemented when walking through the city. Street signs and noticeable storefronts should be easily visible to all pedestrians. This goes into the idea that building facades face the challenge of individual attractiveness and design and need to harmonize with neighboring structures on the block. Considerations include the setback of building entrances from the street, overall height, and alignment to create a cohesive street wall. A well-defined street wall, contiguous with the sidewalk, establishes a protected pedestrian zone, offering a visual corridor for pedestrians. New development should scale appropriately with the existing context, incorporating minimum and maximum building heights. Institutional buildings, such as houses of worship or museums, may intentionally surpass surrounding structures to emphasize their significance. The transparency of storefronts and show windows engages pedestrians and enhances their sense of safety. The welcoming glow from open stores at night contributes to a vibrant streetscape, contrasting with the less inviting presence of shuttered stores or blank walls. Urbanist Jane Jacobs highlighted the connection between ground floor activity, vitality, and crime reduction, emphasizing the impact of having more "eyes on the street." Design measures that prioritize transparency have been proven to deter crime effectively. Creating a safe, welcoming sidewalk environment helps enable pedestrians' sense of safety and social cohesion and boost economic profits.

Another way to incorporate sustainable urban planning infrastructure would be to install permeable walkways, which would help with the heat island effect—figure 6. Thermal Heat in NYC shows what areas in New York experience a more significant effect of UHI. As you can see, areas like the South Bronx are experiencing more heating effects than the Upper West Side, which still instills the notion of unjust urban planning and emphasizes the need for city planners to address these areas first when searching for the most pressing areas to work on.

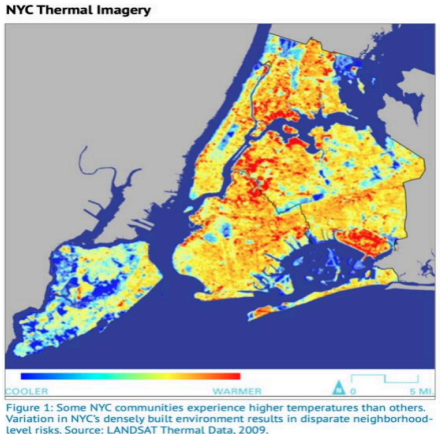


Figure 6: Thermal Heat in NYC[6]

Urban planners must look at sustainable methods when addressing highly heated areas in New York City, such as utilizing community gardens, increasing the density of vegetation in parks, like trees and small ponds, and installing green corridors along roads and walkways. Permeable sidewalks can also be used to mitigate heat islands. Some examples include "porous asphalt, pervious concrete, and permeable interlocking concrete pavement" (EPA, 2020). Permeable pavements consist of a layer of crushed stone aggregate bedding and base, allowing water to pass through the surface. This design enables the pavements to detain stormwater, promoting absorption into the ground temporarily. When installed correctly, permeable pavements offer durable, low-maintenance, cost-effective alternatives to impermeable surfaces. These pavements help with water run-off, absorb heat, and reduce street pollution. The EPA found that "permeable pavements have demonstrated stormwater reduction effectiveness from 25 to 100 percent" (EPA, 2020). This is important because it reduces the amount of standing water and pollutants reaching plant life, ultimately promoting two ecosystem services to reduce the harmful effects of heat islands.

[6] United States Environmental Protection Agency. 2014. "Heat Island Effect." US EPA. February 28, 2014. https://www.epa.gov/heatislands.

Mass transit stations can create connectivity in another part of a well-established walkable city. Connectivity focuses on integrating various modes of transportation seamlessly. This involves well-designed transit hubs, efficient public transportation systems, and infrastructure that supports cycling and walking as complementary modes. Transportation systems, like subways, buses, and trollies, are needed to connect neighborhoods and make commutes faster. However, many public transit systems, like diesel-emitting buses, pollute the city. Switching to electric or hybrid buses and transportation modes would reduce particulate emissions and create safer, healthier city streets. Urban planners should aim to position transportation stops in locations that ensure accessibility for diverse residents. This involves stopping near residential areas, commercial centers, educational institutions, and other vital destinations.

Additionally, connectivity between different modes of transportation, such as bus stops near subway stations, is prioritized to create a seamless network. In New York, “Metro-North stations had prominent stations along major corridors, as currently found at the Fordham station along Fordham Road. As the Bronx progressed from a suburban borough into an extension of urban Manhattan” (NYC.gov). Subway or train stops wane in importance depending on job opportunities, environmental changes, and neighborhood demographics, such as income levels, crime, and employment levels. Urban design that prioritizes green walkability transforms cities into sustainable and inviting spaces. This concept seamlessly integrates lush greenery, tree-lined pathways, and well-maintained public parks into the urban fabric, creating a pedestrian-friendly environment. Green walkability enhances the city's aesthetic appeal and promotes a healthier and more sustainable lifestyle. Including green spaces encourages residents and visitors to stroll, exercise, and connect with nature amid the urban hustle. The well-planned urban design

embraces sustainable landscaping, incorporating native plants and sustainable infrastructure that contributes to environmental resilience. Green walkability is a design element and a commitment to fostering a balanced and harmonious urban ecosystem where people can walk and commune with nature, creating a more resilient and livable cityscape.

Comparative Analysis of New York Walkability and Other Urban Cities

New York City has been ranked as one of the most walkable cities in America due to the city's grid layout, dense infrastructure of sidewalks, and a range of shops, cafes, and attractions, which create an environment where walking is not just a means of getting from point A to B, but an integral part of the city's culture. In NYC, a person can wander through famously known areas like Times Square, Brooklyn Heights, or the High Line, encountering various cultures, cuisines, and architectural wonders in part. The extensive public transit network further enhances this walkable ethos, providing accessibility and connectivity across the five boroughs. When comparing other U.S. cities to NYC, Los Angeles shows the opposite city structure.

While LA has nearly half the population of NYC ("LA has 3.8 million people, and NYC has 8.4 million people"(Zinn, 2024)), LA has a much larger urban sprawl. Urban sprawl is the uncontrolled, often rapid expansion of urban areas into surrounding rural or undeveloped land. This growth pattern often leads to encroachment upon natural habitats, increased traffic congestion, longer commuting times, and a greater reliance on automobiles for transportation. Currently, "Los Angeles County, California has 4,060.2 square miles of land area and is the 11th largest county in California by total area"(*Explore Census Data*, 2024), while comparatively, NYC has "304.6 square miles" (Scoboria, 2023) of land use. This difference in land and population shows how minimizing urban space is essential in making walkable cities. While there is no official ranking regarding LA's walkability, there is a high amount of citizens who

own cars. One study found that LA had an " 87.9% rate of vehicle ownership and an average of 1.63 cars per household" (Paulus, 2022). With a much smaller percentage in NYC, it is only "45.6%" (*TitleMax*, 2020). Los Angeles was built as a haven for care-centered travel, with wide boulevards, expansive highways, and sprawling suburban developments, creating vast distances between destinations and discouraging pedestrian activity. Sidewalks are often narrow and sporadic, with stretches where pedestrians must contend with heavy traffic and minimal pedestrian amenities. The reliance on cars as the primary mode of transportation contributes to congestion, pollution, and a lack of community cohesion.

LA also has limited green spaces and nearby parks for people to walk to. Known as one of the smoggiest cities in the US, "Los Angeles has a median of 3.3 acres of park space per 1,000 people, well below the median of 6.8 acres per 1,000 people in other high-density U.S. cities" (Schoen, n.d.). While landmarks like Griffith Park and Runyon Canyon offer expansive natural settings, they often become overcrowded, particularly on weekends and holidays, diminishing their recreational value and exacerbating congestion and limited access issues. Moreover, many neighborhoods across Los Angeles lack equitable access to green spaces, especially in underserved communities and areas with high population density. Residents of these neighborhoods may have to travel long distances to reach the nearest park or open space, depriving them of opportunities for outdoor exercise, social interaction, and connection with nature. This disparity in access perpetuates inequalities in health and well-being, disproportionately affecting marginalized populations. In the same sense as NYC, there is a high amount of environmental injustice in access to green space. LA's green coalition found that "64% of Californians say poorer communities have less than their fair share of well-maintained parks and recreational facilities…Most residents (58%) agree that compared to wealthier

neighborhoods, lower-income and minority neighborhoods have more than their fair share of toxic waste and polluting facilities" (García & White, 2006). LA shows similar aspects to New York, as impoverished neighborhoods and minority communities are more likely to be restricted from environmental benefits.

The two varying climates of Manhattan and LA illustrate the universality of walkable infrastructure that allows for a transition to more walkable infrastructure easier for urban planners. In LA, urban planners would need to account for the warmer climate by rationing more tree space for shading purposes and using vegetation that survives with a lot of sun exposure. This infrastructure ranges from shadeways, such as tree-cover, to built covering in high-pedestrian areas. One example in Singapore incorporates a built cover over a sidewalk by placing solar panels on it. This type of infrastructure helps with the urban heat island effect and intakes free energy from the sun. It also allows citizens to walk in all weather, rain or shine. Shadeways can also be used in places like New York, with cold winters and hot summers. During the winter months, built covers can block rain and reduce slow and ice risks for walkers, and in the summer, they can be used similarly to LA. Building walkable cities, build sustainable cities that reduce worldwide climate change. LA and Manhattan, as two of the biggest cities in America, must establish frameworks to allocate funding to instating walkable infrastructure. Ways that the local Los Angeles government can improve its city walkability by reducing the number of cars on the streets they must, zone different areas not to allow cars, introducing smaller streets and more pedestrian space on sidewalks, installing shadeways, and planting a variety of vegetation around its city to urge residents to walk more. Additionally, the city of LA must begin to address the environmental injustice towards its low-income and minority neighborhoods by updating mass transit and building more green spaces like public parks and

community gardens while also funding those communities with monetary funds to make storefronts more appealing and provide economic incentive to walk throughout their neighborhoods.

Chapter Four: Shaping Urban Mobility: The Governmental and Economic Aspects of Walkability

Walking and cycling serve as cost-effective and fundamental modes of transportation. Individuals facing physical, economic, and social disadvantages often rely heavily on these non-motorized means, making enhancements in such transportation crucial for achieving social equity and financial goals. Moreover, active transport, primarily through walking and cycling, is the most prevalent form of physical exercise. Encouraging increased participation in these activities emerges as a practical approach to enhancing public fitness and overall health. Non-motorized modes of transportation play a pivotal role in fulfilling various transport planning objectives. These include the reduction of traffic and parking congestion, energy consumption, and pollution emissions. Additionally, they contribute to realizing land use planning goals, such as urban redevelopment and promoting more compact "smart growth" development.

The significance of pedestrian environments, encompassing sidewalks, paths, and hallways, cannot be overstated, as they constitute a substantial part of the public realm. Various beneficial activities like socializing, waiting, shopping, and dining occur in these environments, prompting the importance of their quality. Walkable environments are especially vital for the prosperity of shopping districts and resort communities, attracting customers and fostering economic activity. Beyond their practical functions, walking and cycling are popular recreational activities. Enhancing the conditions for walking and cycling allows users to derive enjoyment and health benefits and supports related industries such as retail, recreation, and tourism.

Moreover, investing in improving non-motorized transportation benefits individuals, communities, and the broader economy.

Biking in New York City offers a way to be physically active and garner a deeper understanding of various neighborhoods for those who opt to bike. With delayed and dangerous subways, more people in New York are taking up biking, as (NYC DOT, 2024) shows that "30% of adult New Yorkers (approximately 2 million people) ride a bike." Local governmental departments in Manhattan have shown great strides in creating bike lanes throughout the city as "1,525 lane miles of bike lanes installed in New York City as of 2022 and 644 lane miles of protected bike lanes installed in New York City as of 2022" (NYC DOT, 2024). This is significant because it illustrates how the government has put time and effort into making Manhattan and its surrounding areas more environmentally friendly. Similarly, however, there are clear signs of deflecting low-income areas like the Bronx in the amount of bike paths created and the safety of the existing ones. Although Manhattan is comparatively smaller than the Bronx, the Bronx has fewer committed miles of bike lanes than Manhattan.

Additionally, Manhattan's bike lanes are more likely to be protected. Located on the Upper West Side, the Hudson River Parkway is one of Manhattan's most protected designated bikeways. Currently, the Bronx is ranked fourth least bikable out of the five boroughs, according to (Saab 2021). Despite this, the NYS government has begun making strides to provide more equitable access to bike paths. The government is starting numerous projects in the Bronx, one of the most significant projects being the Harlem River Parkway. They plan to create up to seven miles of multi-modal pathways connecting Randall's Island to Van Cortland Park. "The implementation plan will aim to better connect Bronxites to their waterfront and provide a critical north-south bike commuting corridor" (DOT Harlem, 2024). This leads to equitable

access to New York City's natural areas and provides the South Bronx with neighborhood attributes similar to the Upper West Side. On another note, Governor Kathy Hochul announced, "The New York State Department of Transportation has been awarded a $150 million federal grant to help transform an initial section of the Cross Bronx Expressway with the addition of a multimodal community connector roadway, featuring dedicated bus lanes and pathways for bicyclists and pedestrians" (NYS, 2024). This is a significant win for the South Bronx as an environmental justice zone.

Economics in Walkability

The advantages of nonmotorized transportation, explicitly walking and cycling, extend beyond mere health benefits to encompass economic and environmental considerations. As illustrated in Figure 7, these modes of transportation proved to be notably more cost-effective and resource-efficient than alternative commuting and recreation forms. While acknowledging that walking and cycling may not suit every purpose, the data underscores the substantial financial and resource savings that can be realized through their adoption, contributing to a more sustainable and economical transportation landscape. This emphasis on the economic and resource advantages of nonmotorized transportation aligns with the words of Jane Jacobs, aptly capturing the essence of sustainable urban mobility, stating, "Cities have the capability of providing something for everybody, only because and only when everybody creates them."

Affordable and Efficient	Expensive and Resource Intensive
Walk and bike for transport	Own and operate an automobile
Walk and bike for exercise	Join a health club
Walk and bike children to school	Chauffeur children to school
Build sidewalks	Build roads and parking facilities

Figure 7: Non-motorized Transport Is Generally Cheaper Than Alternatives[7]

[7] Litman, Todd Alexander. 2003. "Economic Value of Walkability." *Transportation Research Record: Journal of the Transportation Research Board* 1828 (1): 3–11. https://doi.org/10.3141/1828-01.

The significance of nonmotorized transportation, mainly walking, is underscored by its profound influence on people's perceptions of the transportation system and the surrounding environment. Therefore, “walking conditions have a major impact on how people perceive the transportation system and the local environment since we experience activities by the amount of time they take, not just the distance traveled” (Litman 2003). Litman brings forward the idea that walking is not always used in public surveys regarding transportation. Traditional traffic surveys frequently overlook various pedestrian activities, neglecting individuals sitting or waiting on sidewalks, engaging in activities such as skating or skateboarding, or simply walking from vehicles or buses to buildings.

As shown in prior research, the root economic idea of walkability indicates that an area's walkability is influenced by its land use and built environment infrastructure, with the pedestrian amenities of neighborhoods mirrored in real estate prices. As (Longo et al., 2015) point out, “walking in a neighborhood is a good not traded in any market.” Further, it explains that to “evaluate both the demand response and monetary advantages associated with transportation walking and recreational walking within the local neighborhood, we employ a non-market valuation technique. In this approach, the quality of a neighborhood is considered a non-market or public good” (Freeman, 2003.) In (Longo et al., 2015) conceptual framework, they presume that individuals derive personal satisfaction or private utility from walking in a residential neighborhood. Additionally, they assume 'weak complementarity' between walking behavior and the pedestrian attributes of a neighborhood. This theoretical stance implies that an enhancement in a neighborhood's walkability corresponds to an increase in the frequency of walking within

that particular locale, aligning with findings presented in the works of Saelens and Handy (2008) and Wilson et al. (2011).

The theory of weak complementarity suggests that the value or willingness to pay (WTP) for public goods is equivalent to the value of access to the associated private goods (Freeman, 2003). This theory is applied to ascertain the value of walking in a neighborhood. The calculation involves estimating the Hicksian demand function, (the formula being "yield the amount of good x1 purchased at prices p1 and p2 when income is just high enough to get utility level u0. Hicksian Demand Curves must slope down" (Bhattacharya 2001, 2)), for walking and then determining the compensating variation in a hypothetical scenario where pedestrian access to the neighborhood is restricted. The compensating variation represents the income adjustment required to offset an external change in the provision of the good while maintaining the individual at the initial level of utility. Decision-makers aim to assess the impact of alterations in various aspects of neighborhoods, including changes in walking patterns, the response in demand for walking, and modifications to infrastructure. The valuation of transformations in neighborhood features involves estimating the demand curve considering current and modified neighborhood characteristics. Subsequently, the compensating variation and the shift in walking demand are computed to evaluate the anticipated effects of the proposed policy changes. The study of walkability economics is crucial as it directly intersects with public health, urban planning, and economic development. Understanding the economic implications of walkable environments is vital in fostering sustainable and vibrant communities.

In a comprehensive 1998 report, Collaborative Economics conducted an in-depth analysis exploring the intricate relationship between the physical design of communities and the dynamic aspects of the emerging knowledge-driven, service-oriented economy. This evolving economic

landscape, characterized by smaller and decentralized firms, draws inspiration from land use patterns reminiscent of the early industrial era. These patterns feature city centers, corner stores, and streetcar suburbs that facilitate a symbiotic environment. Notably, walkable downtowns emerge as pivotal components, offering a vibrant blend of restaurants, offices, and housing, fostering a conducive atmosphere for social interaction. Recognizing the significance of accessibility, networking, and creativity in the contemporary economy, this study underscores how walkability becomes an asset for the flourishing dynamics of the knowledge-driven and service-oriented sectors. The relationship between physical urban design and economic prosperity unveils insights into the adaptive nature of communities in accommodating the needs of a transformative economic era.

As a case study, we have the city of Lodi, California, with a population of 60,000, which initiated a noteworthy public-private pedestrian-focused endeavor, investing $4.5 million in a comprehensive project. This initiative retrofitted five main street blocks, spanning from building face to building face, emphasizing School Street. The enhancements encompassed the widening of sidewalks, the strategic bulbing out of curbs at intersections, and the incorporation of vibrant paving stones into the newly revamped sidewalks and streets. The transformation also included the installation of a distinctive gateway and the introducing of 140 street trees, along with thoughtful additions such as lighting, benches, and various other streetscape amenities. This ambitious project aimed to revitalize and enhance the downtown area, creating an inviting and aesthetically pleasing environment for residents and visitors alike. The city credited “the pedestrian improvements, as well as economic development incentives, with the 60 new businesses, the drop in the vacancy rate from 18% to 6% and 30% increase in downtown sales tax revenues” (Ryan, 2003). Lodi provides a practical demonstration of how public-private

partnerships can be instrumental in executing such projects. The collaboration between the public sector and private entities showcases a viable funding model that can be replicated in other cities looking to improve their urban infrastructure substantially.

This section highlights the multifaceted advantages of nonmotorized transportation, explicitly walking and cycling, extending beyond health benefits to economic and environmental considerations. Nonmotorized transport proves notably more cost-effective and resource-efficient, as depicted in Figure 6. The economic concept of walkability, influenced by land use, built environment, and real estate prices, emphasizes the non-market value of walking. The case study of Lodi, California, exemplifies successful public-private investments in walkability, resulting in tangible economic and community benefits. Understanding walkability economics is crucial for shaping sustainable, vibrant communities and underscores its pivotal role in economic prosperity, environmental sustainability, and community well-being.

The Governmental Role in Walkable Cities

Governments at various levels—local, regional, and national—possess the authority and responsibility to enact policies, regulations, and investments that shape the built environment and influence transportation systems. By prioritizing walkability in urban planning initiatives, governments can promote safer, healthier, and more vibrant communities while addressing pressing challenges such as traffic congestion, air pollution, and social isolation. Socialization is the key to cohesive governments and instilling a sense of trust in the community. The expansion of walkable areas and refurbishment of cities with a high population of citizens are required to provide ways to promote social cohesion. Within neighborhoods, the“higher frequency of seeing people walk within sight of the home may elicit feelings of safety and trust in neighbors, and in turn influence neighborhood social cohesion” (Murillo et al. 2019). This notion shows that

neighborhood locals' facial recognition fosters a sense of familiarity and oneness in large cities. Humans are social animals and need to fulfill interaction to stay mentally healthy. Humans are not supposed to feel isolated, and cities lacking walking infrastructure deny humans the option to meet new people, see friends, and be physically healthy.

On another note, as demonstrated in the case study on Lodi, California, walking facilitates economic exchanges and monetary reductions in governmental spending on public transportation and vehicle-dominated roads. Walkable cities attract businesses, investors, and talent by offering vibrant, accessible urban environments that cater to diverse needs and preferences. Pedestrian-friendly streetscapes and vibrant public spaces enhance residents' quality of life and serve as magnets for tourism and commerce, bolstering local economies. Additionally, walkable neighborhoods tend to have higher property values and attract higher-income residents, increasing tax revenues for municipalities. Moreover, by reducing reliance on automobiles and encouraging active transportation modes like walking and cycling, walkable cities can lower transportation costs for individuals and households, freeing up disposable income for spending and savings.

Furthermore, investments in pedestrian infrastructure create jobs and stimulate economic activity in the construction, design, and maintenance sectors. To achieve the ideal walkable city, local and state governments need to work with community groups to understand what is needed and where in terms of funding and what its citizens want from their surrounding natural environment. Working with residents creates a sense of ownership in residential areas, making people feel inclined to take care of newly restored streets and sidewalks and to spend more time in them. Creating policies around ownership is essential when striving for walkable neighborhoods. People want to feel safe walking from crime or high-car volume areas. Local

governments need to enforce slower speed limits in heavily residential areas as this will reduce car-related deaths or injuries and also put walking over driving. This looks like increasing and updating signage, blocking off residential streets to car access, installing bike locks, and widening sidewalks for more walkways for pedestrians to walk. Governments also need to facilitate economic incentives, like government-owned museums within walking distance, subsidized costs for small business owners, and incentives for people to buy locally and within walking distance from their houses.

One way in which the New York City government has implemented strategies to transition to a more walkable and environmentally friendly city is the "Open Streets" program. This facilitates "economic development, supports schools, and provides the public with opportunities to enjoy cultural and community programs" (Open Streets, 2024). The government created three types of open streets for residential enjoyment and the first is limited local access streets designated for pedestrian and cyclist use and enjoyment during specified hours and days each week. Local vehicle access is permitted for parking, passenger drop-off or pickup, deliveries, and loading. The second is a wholly closed street where the whole street is open for use, whether for block parties, celebrations, or festivals. Lastly, there is a fully closed street specifically for schools to create safe outdoor spaces for events in an urban city. This promotes social cohesion among neighbors and provides economic benefits by finding local businesses to sell and bringing people to open street events. While it is not specifically an open street event, the Bronx night market is an excellent example of how closing off specific urban areas for public events facilitates residential spending. It also promotes local businesses and generates awareness of neighborhood shops.

A significant strategy underway is PlaNYC, founded in 2007, a long-winded action plan provided by the NYC government to implement more sustainable lifestyles in New York City. With multiple plans supplementing the overall goal of a more eco-friendly NYC, the current plan is “Getting Sustainability Done” as of 2023. A more comprehensive understanding of climate change impacts in the city provides a complete picture of greenhouse gas (GHG) emissions, including a new consumption-based inventory. For the first time, emissions are analyzed within the city's geography and throughout the lifecycle of the food and products consumed by New Yorkers. This plan emphasizes environmental justice and public health, recognizing that despite improvements in air quality citywide, environmental justice communities continue to suffer adverse health outcomes due to air pollution and climate hazards. However, these challenges also offer opportunities to enhance environmental conditions and promote prosperity, equity, and community well-being. A specific way the government carries out this plan is the framework of climate budgeting, which is “a shift from status quo to holistic decision-making” (Adams, 2023). The components of this budget show that this new framework allows the government to allocate budget spending fairly. “Some investments are made to reduce emissions or increase resilience. Other programs and services, including increasing affordable housing, maintaining infrastructure in good repair, and procuring food for students, also impact our climate goals” (Adams, 2023). Publishing these budgets allows for a more profound sense of transparency within Manhattan and shows residents how their government is handling their funding for climate change. As a subset of PlaNYC, local leaders have established the Green Economy Action Plan, which encompasses leadership commitments to push businesses, nonprofits, and residents to collaborate by building a sustainable and equitable green economy system. The action plan has five goals set in place: 1) Decarbonize buildings and construction, 2) Develop a renewable energy system, 3)

Enable low-carbon alternatives in the transportation sector, 4) Catalyze innovation in climate technologies, and 5) Build an equitable green economy ecosystem. All of these individual goals aim to create an environmentally friendly New York by incorporating sustainable practices into hundreds of jobs in the city, and with more people practicing an eco-friendly way to work, they will take it into their personal lives. They are promoting a more profound community acknowledgment of sustainable practices and shifting from the non-holistic mindset. “It is projected to continue proliferating: by 2040, the City’s green economy is projected to employ nearly 400,000 people—7 percent of all jobs in New York City—and contribute $89 billion to its GDP” (Torres-Springer, 2024). Action plans such as this should set a precedent for other large cities in America and globally.

To further support PlaNYC, several smaller-scale policies and strategies have been set. WalkNYC provides a plethora of newly installed signage at bus stops in densely popular areas that provide convenient maps to help you find your way around. CitiBikes is installed to implore biking and another option for physical activity. New York City has also committed to re-vamping public parks and making them more aesthetically pleasing and appealing. The NYC Parks Equity Initiative focuses on community parks that are “densely populated, growing, and contain higher-than-average concentrations of poverty”(NYC Parks, 2024). Lastly, In July 2019, the Department of Transportation implemented Green Wave: A Plan for Cycling in New York City," outlining the main components of reaching city bicycle goals. These goals encompass constructing 30 miles of protected bike lanes each year, establishing 75 miles of cycling infrastructure within ten priority districts by 2022—seven in Brooklyn and three in Queens—and aspiring for bicycles to represent one out of every ten trips in NYC by 2050.

Overall, governmental strategy and plans for walkable cities are essential to move from car-centric streets towards a more pedestrian-friendly framework. A known urban planner, Jeff Speck, has remarked on why walkable cities need to shift to a cleaner and longer-lasting urban environment. One quote from his book, “Walkable City: How Downtown Can Save America, One Step at a Time,” emphasizes the importance of walkability by enlightening the reader with this mindset: “God made us walking animals—pedestrians. As a fish needs to swim, a bird to fly, a deer to run, we need to walk, not in order to survive, but to be happy” (Speck, 2013). Simple yet, this quote perfectly illuminates why walkable cities are a goal all strive for, not only because they benefit humans but also because it promotes a healthier planet.

Chapter Five: Building Walkable Cities: Solutions and Existing Plans for Urban Accessibility

New York City and Other Cities as an Example

A successful walk must provide a mix of uses, typically found in downtowns and main streets, where commercial and residential activities coexist seamlessly. Safety, a critical aspect, requires thoughtful street design to deter speeding and ensure pedestrian well-being. To achieve true walkability, a place must excel in all these aspects, presenting a challenge often met in downtowns and main streets with concentrated efforts. While the private market plays a crucial role in aligning streets, cities can influence walkability through grants, zoning, and short-term improvements focusing on safety. Jane Jacobs' emphasis on small blocks with more intersections aligns with the idea that walkable areas have more eyes on the street, enhancing safety and reducing crime. Block density and intersection density become vital indicators of walkability, with examples like Portland's 200-foot blocks contrasting Salt Lake City's less walkable 600-foot blocks. The pedestrian-friendly infrastructure of New York City demonstrates the transformative potential of prioritizing walkability in urban planning. New York's successful integration of

mixed-use spaces, safety measures, and visually engaging environments is a model for other cities aiming to enhance their walkability. A NYC consensus showed that "a total of 2,804,410 residents of New York City (34%) live in Census blocks that score in the top quartile of the walkability index and 1,022,942 residents (13%) live in Census blocks that score in the lowest quartile" (Rundle et al. 2014). This census information shows that residents in New York City are getting outdoor access through walkable pathways. By studying and emulating the principles that contribute to the pedestrian success of cities like New York, urban planners can learn valuable insights to inform their initiatives, fostering more sustainable, livable, and economically vibrant urban environments across the globe.

Various cities are introducing new urban concepts or models to address the issues mentioned above to varying degrees. Examples include superblocks, low-traffic neighborhoods, the 15-minute city, car-free cities, or hybrid combinations of these approaches.

Figure 8: Examples of More Walkable Cities[8]

"What these models have in common is that they aim to reduce private car use and increase public and active transportation (walking and cycling), thereby reducing air pollution, noise, and heat island effects, increasing physical activity, and promoting and improving health"

[8] Nieuwenhuijsen, Mark J. "New Urban Models for More Sustainable, Liveable and Healthier Cities Post Covid19; Reducing Air Pollution, Noise and Heat Island Effects and Increasing Green Space and Physical Activity." *Environment International* 157 (December 2021): 106850.

(Nieuwenhuijsen, 2021). Green urban planners, city policy, and government-devoted funds are required to make city-wide changes toward more walkable cities. Given the benefits of walkable cities, governmental leaders need to make more concerted efforts to fund sidewalk and storefront infrastructure, update and install clear, visually appealing signage, and a more significant amount of government involvement in limiting vehicle emission pollution in urban centers. Inverting the traditional transport planning pyramid involves shifting the planning priority from cars to emphasizing public transportation, walking, and cycling (see Fig. 9). This approach allocates more public space and develops additional infrastructure for the desired modes of transportation, with a particular focus on expanding safe cycling infrastructure.

Figure 9: Optimal Transport Planning Pyramid

[9]Expanding the cycling infrastructure to boost cycling rates is a strategy to decrease motorized traffic and CO2 emissions. This initiative promotes active mobility, enhances physical activity levels, and improves overall health. While city planners must focus on creating better sidewalk infrastructure, they must also allocate space for safer bikers. Biking is also a way to

[9] Nieuwenhuijsen, Mark J. "New Urban Models for More Sustainable, Liveable and Healthier Cities Post Covid19; Reducing Air Pollution, Noise and Heat Island Effects and Increasing Green Space and Physical Activity." *Environment International* 157 (December 2021): 106850.

promote physical activity and make it safe. Biking is pivotal in shaping a sustainable and active urban lifestyle in cities with enhanced walkability and abundant green spaces. The benefit of pedestrian-friendly infrastructure and lush greenery creates an inviting environment for cyclists, transforming commuting into a leisurely and environmentally conscious experience. Biking in these urban havens is an efficient mode of transportation and contributes to reduced carbon emissions, aligning with the cities' commitment to eco-friendliness. The interconnected networks of walkable paths and bike lanes connect green spaces, fostering community and well-being. The availability of dedicated cycling infrastructure in these urban landscapes not only promotes physical health through increased activity but also augments the city's overall aesthetic and ecological appeal, encouraging residents and visitors to embrace a sustainable and two-wheeled mode of exploration.

A model developed by (Fitzsimons, 2013), shown below, indicates the importance of the functional environment, which involves components- density, connectivity, permeability, and land use—in influencing urban walkability. The streetscape focuses on visual elements and plays a pivotal role at a micro level. This helps influence perspectives on transportation, public health, and urban design. The built environment, the artificial surroundings for human activities, directly correlates with walkability, particularly in urban planning and health. “A dense area with a high level of diversity and short distance access to the services and public transit stop has more potential to be a walkable and sustainable area” (Rafiemanzelat et al., 2017). This is shown in several studies and is pushed through many policies to integrate better mixed-land-use zoning codes that exemplify this type of community. This is why urban cities are essential in starting the transition to more walkable places, and the city's density is the perfect environment to instill this type of infrastructure.

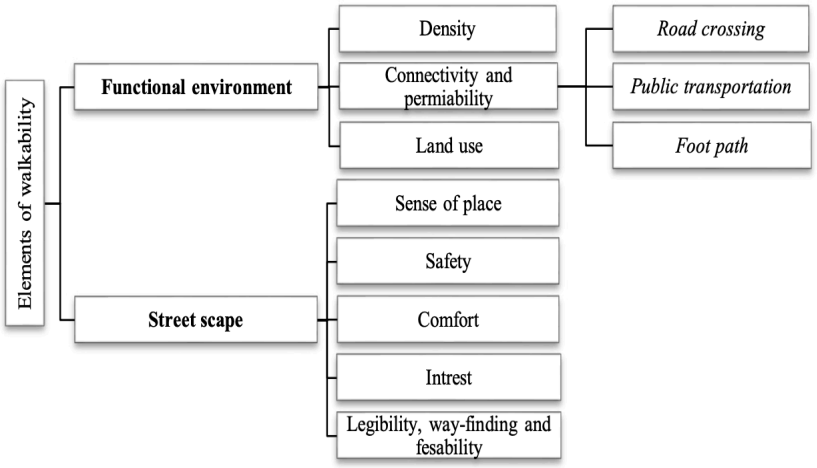


Figure 10. Correlated elements of walkability and built environment [10]

Overall, the critical components of a walkable city include traversable environments characterized by primary physical conditions facilitating seamless movement from one place to another. Compact places offer the advantage of short distances to destinations, which is especially beneficial for those walking for utility purposes. The safety of walking environments encompasses various things, including perceived and actual crime rates and traffic safety, all addressing potential harm to individuals. Physically enticing environments go beyond the basics, featuring full pedestrian facilities like sidewalks or paths, marked pedestrian crossings, appropriate lighting, street furniture, helpful signage, and street trees. These environments incorporate elements of interest such as captivating architecture, pleasant views, and many services, appealing to individuals with alternative transportation choices seeking convenience and exercise.

Some recommendations for creating walkable cities require a comprehensive approach encompassing various policy recommendations. First, a significant investment in pedestrian infrastructure, including well-maintained sidewalks, crosswalks, and pedestrian bridges, is

[10] Rafiemanzelat, Reihaneh, Maryam Imani Emadi, and Aida Jalal Kamali. "City Sustainability: The Influence of Walkability on Built Environments." *Transportation Research Procedia* 24 (2017): 97–104. https://doi.org/10.1016/j.trpro.2017.05.074.

crucial. Implementing and enforcing "Complete Streets" policies during road design and construction is essential to prioritize the safety and accessibility of all users, including pedestrians, cyclists, and public transit users. Mixed-use zoning regulations and transit-oriented development initiatives should be pursued to create neighborhoods that seamlessly integrate essential services, retail, and recreational facilities, encouraging residents to walk. Safe Routes to Schools programs can enhance the safety of walking routes for children, fostering active transportation. Engaging the community in urban planning ensures local preferences are considered, building a sense of ownership. Traffic calming measures, green spaces, and well-maintained public areas contribute to an attractive, pedestrian-friendly environment. Additionally, the integration and expansion of bicycle infrastructure provide alternative sustainable transportation options. Lastly, organizing pedestrian-friendly events and promotions can further encourage a culture of walking within the community.

Conclusion: Walkability Importance– A Concept to Strive For

In this thesis, several factors were considered to promote walkability in urban cities, where New York City was evaluated and considered a role model for other cities worldwide. New York City has many plans for the city's future in terms of advancing its sustainability goals, such as OneNYC. This plan looks to 2050 as the year in which it will be comparably more inhabited, have a greater sense of community trust, provide more equitable and budget-friendly healthcare, be equipped with modern and sustainable architecture, and have better economic development. The multi-faceted plan has become a guidepost for most current policies and strategies in New York and has already shown excellent results. Since 2015, the New York government has cut GHG emissions by 15 percent and reduced pedestrian fatalities by 45 percent due to its VisionZero program that instilled walkable design, enforcement of safety regulations,

and education. It also has reclaimed the streets for pedestrian interest over automobiles.

New York still has significant work to prioritize pedestrian safety and create enjoyable outdoor spaces. Environmental injustices are still prominent, as shown in the comparison of the Upper West Side and South Bronx neighborhoods. The South Bronx is riddled with health concerns that stem from intentional zoning and lack of funding. The stark differences in income and access to green space and health disparities highlight the need to reevaluate governmental spending so that it is allocated more toward neighborhoods that have taken a toll from the "NIMBY"-- Not In My Backyard mindset that has plagued white neighborhoods and governmental institutions. This mindset predates the "out of sight, out of mind" belief that creates selfish tendencies. For example, affluent, primarily white neighborhoods have the funding and platform to dismiss proposed facilities like waste dumps and petrochemical industries trying to gain access to their neighborhoods. However, EJ areas have less funding and no platform to push against these propositions. They have no choice. Furthermore, simply, white, wealthy neighborhoods turn their backs and refuse to help. Grassroots organizations will be essential in forming solid platforms and governmental connections to help eliminate inadequate neighborhoods, housing, and health effects in environmental justice areas. It is essential to address environmental justice areas first when constructing or transitioning to walkable cities, as they have the most at stake. Creating pleasant outdoor spaces accessible from air pollution, crime, and poor sidewalk/street atmosphere must start now. Re-designing and supplementing current parks in the Bronx will help connect South Bronx residents to their city, inspire physical activity outside, and offer a new sense of social cohesion. The Bronx is Blooming is a non-profit organization that revitalizes community parks by bringing diverse people together to help restore park space. This organization is a role model for other groups to get together and find ways to

address the lack of green areas in the Bronx.

Walkable infrastructure is paramount in creating a sustainable city and, thus, a sustainable world. Using green tools like green facades, green roofs, solar panels, sidewalk vegetation, and permeable walkways will make cities more enjoyable and climate-friendly to walk and live in. Air pollution, the heat island effect, and health concerns like obesity and asthma would decline. Connect communities by prioritizing social mobility and easy access to biking and walking paths that get you safely from point A to point B. Western philosophy and culture have prioritized a "money-making" mindset, where there is no time for natural enjoyment, social unity, and interaction with nature. Native American philosophy prides itself on "being one with nature" and chooses to have a special relationship with the land and all people, as they believe everything and anything is interconnected, learning from one another. "Braiding Sweetgrass" by Robin-Wall Kimmerer shows the stories, spirituality, and unprofound respect Native American tribes across America have valued for hundreds of generations. These aspects need to be brought forward to contemporary belief and consciousness, as they pertain to sustainability and respecting the earth we call home. This specific quote says, "Something essential happens in a vegetable garden. It is a place where if you cannot say "I love you!" out loud, you can say it in seeds. And the land will reciprocate, in beans" (Kimmerer, 2013), emphasizing the reciprocity that is essential in all forms of natural life. This belief comes when humans interact with nature, even through a community garden, a mutual relationship– a human gives soil water and love. The land gives a plant something substantial back. Native American cultural epistemology is the knowledge that all humans must try to learn from, as it only teaches humans not to think of themselves as the most important thing on earth. Learning this mindset will go a long way in shifting towards a more walkable city and a reciprocal relationship with urban nature.

As one of the most accessible and inherent forms of sustainability, walkability in urban cities is a concept that all cities must begin to address. In the time of ever-pressing climate change action, creating walkable cities and urban spaces will ultimately lead to a decrease in air pollution by reducing the need for emitting transportation like buses and cars. With that, human familiarity with their surroundings will provide communities with the means to facilitate organized events and activities that allow for social connectivity. Walkable neighborhoods with local grocery stores and shops, doctors' offices, religious institutions, and public parks establish a better mental state and less feelings of isolation. It also boosts the economy by incentivizing residents to purchase from conveniently located stores and supply an increasing value on retail and houses. One drawback to walkable neighborhoods is that it incentivizes affluent people to push out people who have resided in the area for years. However, an increasing economy and property values force the long-term residents to flee. This is gentrification, happening to large cities and suburbs all over America. If government intervention prioritizes switching to walkable practices for all neighborhoods, fair access to all areas will hopefully be. This would help diversify neighborhoods instead of segregating them. Government leaders are essential in facilitating this change and partnering with local community organizations and environmental urban planners. By utilizing urban planners who prioritize sustainable architecture, cities will look more aesthetically beautiful, show native species to tourists, and curb rising temperatures. Walkability is overlooked when mitigating climate change, and raising awareness of the importance of walkability will be critical in the coming years.

In summation, there is a pressing need to restore our world’s natural ecosystem to balance and reciprocity. Since nearly 83% of the United States population resides in urban areas and cities and is a significant contributor to greenhouse gas emissions, transitioning to more

eco-friendly modes of transportation, such as walking, is vital. The benefits of walkability extend beyond environmental considerations; they encompass economic prosperity, community cohesion, and overall quality of life. With pedestrian-friendly infrastructure and the promotion of mixed land-use development, cities can mitigate environmental impact, spur economic growth, and enhance residents' well-being. However, achieving true walkability requires a comprehensive approach that involves policy changes, urban planning strategies, and community engagement.

With the ever-impending climate change crisis, nations and their governments must focus on strategies to mitigate human-centric lifestyles, like choosing to drive rather than bike. Urban planners must use sustainable materials to curb indoor and outdoor temperatures when constructing new buildings. Installation of solar panels is essential in reducing electricity usage in large cities and using renewable energy from the sun's UV. Educational programs for large city residents regarding sustainable transportation and lifestyle choices will help shift the public's environmental mindset. Like the Native Americans, philosophy communities need to create a sense of reciprocity within their neighborhoods and their surrounding environment. To summarize, author and urban planner Jeff Speck says, “Every city has the potential to become a walkable city, it just requires the will and commitment to make it happen” (Speck, 2013). As Speck suggests through this quote, the essential factor for accomplishing this goal resides in the determination and dedication of both residents and authorities. Embracing an approach to urban planning that centers on sustainability and the needs of people, cities can give precedence to pedestrians and forge environments that are secure, reachable, and pleasurable to traverse by foot. This calls for a collaborative endeavor involving all parties, such as policymakers, urban planners, community influencers, and inhabitants, to conceive and execute strategies and

structures that enhance walkability. Overall, more attention should be paid to the benefits of walkable cities to pave the way for a more sustainable and inclusive future where cities thrive as vibrant, community-based centers of activity and innovation through dedicated efforts to advocate for pedestrian-friendly urban spaces.

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