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Abstract:

The Advancing Climate Justice in Climate Adaptation Strategies for New York City (Equity) chapter of NPCC4 builds on the findings and recommendations from NPCC3 to identify additional metrics and adaptation efforts that can advance climate justice. First, the chapter assesses the efforts of the city to incorporate equity into climate adaptation efforts since NPCC3 and describes how the communities profiled in NPCC3 have implemented and evolved their approaches to addressing the intersecting climate, environmental, and social stressors that they continue to face. Second, it adds to the historical context of climate inequity by linking the bioregion's history of colonization, land dispossession, and slavery building on emerging evidence demonstrating how historical and contemporary land use patterns and decisions shape present and future climate risks and social vulnerability, including climate displacement. Third, it recommends a NYC focused metric to identify areas of the city that are most vulnerable to the intersection of climate hazards, social vulnerability, and displacement. Finally, it highlights approaches to more equitable and just climate adaptation drawn from local, national, and international examples. As such, the chapter offers best practices that prioritize community-driven climate resilience approaches that are integrated, more equitable, and racially just.

Keywords:

Equity, Social Vulnerability, Colonization, Climate Displacement, Community-Driven Climate Resilience, Racial Justice, NPCC4

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Table of Contents

1 Introduction

Equity is an essential part of climate adaptation and resilience efforts for cities. The NPCC3 report featured equity dimensions of climate adaptation using several metrics and case studies applicable to New York City (NYC). The NPCC3 report metrics included well-established social vulnerability indices and a tripartite framing of climate equity using distributive, procedural, and contextual concepts. NPCC4 builds on this climate equity approach and expands it to reflect the developing literature on climate justice. Climate justice is defined in the IPCC as "[j]ustice that links development and human rights to achieve a human-centered approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly" (IPCC, 2022). The term implies that climate adaptation and mitigation efforts must account for differential impacts and equitable allocation of benefits and burdens that considers drivers of climate change, including global economic systems dependent on resource extraction, as well as legacies of colonialism and racism. To advance climate justice, NYC must attend to how historical legacies of discrimination and bias drive climate risks and unequal vulnerability to those risks.

1.1 Key Messages

Key Message 1: The City's climate-related equity work since 2019 has become more explicitly focused on redressing environmental injustice and racial disparities. *Over the past five years, the City has embarked on four interrelated sets of actions to foster and advance equity in its approach to climate adaptation: (1) adoption of multiple laws and programs to address equity issues related to climate change impacts, (2) internal institutional reforms in the provision of city services; (3) development of indicators and metrics and digital, interactive, and mapping platforms that are publicly accessible to track and monitor city agencies' progress; and, (4) incorporation of equity into ongoing climate risk assessments and in sustainability and resilience planning.*

Key Message 2: The City's climate-related equity work would benefit from more comprehensive data on disaggregated climate risks at the local level and tracking of city-sponsored climate adaptation projects and resilience investments. *There is limited understanding of climate change impacts and adaptation needs at the community or neighborhood level and limited systematic data exists on city-sponsored adaptation projects and resilience investments. More disaggregated climate risk data and systematic tracking of city-sponsored climate investments are needed.*

Key Message 3: Some of the city's most marginalized communities have evolved their approaches to combat a variety of environmental, climate, and social stressors. *The organizations profiled in NPCC3's equity section report that they are implementing dynamic approaches to address the various risks they face while providing multiple benefits to their communities. These benefits include expanding access to solar energy and providing upgrades for cooling residences experiencing high heat and air pollution exposure.*

Key Message 4: The climate change challenges that New York City faces are inextricably linked to the bioregion's early history, including slavery and land dispossession. *Understanding the impacts of this history is vital for formulating effective policies and strategies to mitigate and adapt to climate change. An appreciation of the historical legacy of climate impacts on the region, and on certain communities, also necessitates a commitment to reparations and restorative justice. By recognizing Indigenous knowledge, seeking restorative justice, and reconceptualizing our relationship to land, the City can forge a future that respects the environment, promotes social justice, and ensures the well-being of all communities.*

Key Message 5: Climate risks for the most socially vulnerable populations are linked to both past and present land use decisions and patterns and their underlying inequities. *Although the relationships between historical land use and climate risk are complex and context-dependent, they often have similar underlying mechanisms such as past discriminatory land use and siting decisions, redlining and disinvestment, and lower land costs in hazard-prone areas. Many of these land use issues—past and present—reinforce one another and create future risks and vulnerabilities. Without the creation of climate mitigation, adaptation, and resilience policies and practices that promote racially equitable procedures and outcomes, the City will risk perpetuating these inequities in new forms.*

Key Message 6: Climate displacement is an important dimension of social vulnerability to climate change and should be measured by the City. *The City's ability to measure the risks of climate displacement at an appropriate scale, such as at the neighborhood level, could help determine whether and how new infrastructure or infrastructure investments designed to help the city adapt to climate impacts might risk displacement and identify ways to mitigate that risk. Use of a combined climate displacement and social vulnerability (CDSV) score is proposed to integrate socio-economic, climate risk, and evictions and housing data to better measure the risks of climate displacement at the census-tract level.*

Key Message 7: Without anti-displacement strategies in place, resilience-promoting investments can have inequitable outcomes. *These strategies require several key approaches: (1) incorporating contextual equity and understanding the history of places down to the neighborhood level; (2) taking a holistic approach to reducing racialized vulnerability to climate shocks, including inseparable issues like housing and transit access; and, (3) recognizing that the cost burdens of climate adaptation (e.g., higher energy costs, insurance premiums, relocation) affect people differently—particularly when considered in light of homeownership and wealth gaps—and can result in increased displacement risks.*

Key Message 8: Key to achieving equitable climate adaptation is to prioritize community-driven climate resilience approaches. *As an example of successful approaches, community-based organizations featured in NPCC 3 have implemented climate adaptation initiatives that were attentive to the intersecting nature of climate risks and other health vulnerabilities, including the COVID-19 pandemic. These initiatives include climate mitigation strategies and provide multiple benefits including equitable access to renewable energy, affordable and efficient housing, and economic development strategies that promote equitable green, adaptation economies.*

Key Message 9: Best practices from around New York City and the world highlight the importance of integrated, affirmatively anti-racist, equitable, and just approaches to tackling climate risks. *The three broad categories of best practices identified for more equitable and racially just climate adaptation approaches are: (1) integrative approaches to climate resilience that seek out opportunities to advance just transitions and adaptive economies; (2) community-**led** planning processes that make adaptation plans more successful in the face of intersecting housing and climate displacement risks; and, (3) collaborative development of goals, programs, policies by leveraging relationships between communities, civic organizations, and state and local government offices and programs.*

1.2 Chapter Scope and Context

The Advancing Climate Justice in Climate Adaptation Strategies for New York City (Equity) chapter builds on the findings and recommendations to the City from the NPCC3 equity workgroup to identify additional metrics and adaptation efforts that can advance climate justice. The NPCC3 report (Foster et al., 2019) found that social vulnerability to climate change stressors is unequally distributed across African American and Hispanic residents. The report also found, based on qualitative case studies of communities with high levels of social vulnerability, that those communities also face intersecting stressors such as disproportionate pollution exposure and gentrification pressures, which are aggravated by climate change impacts (Anguelovski et al., 2019). Finally, the report found that these same communities are involved in many forms of adaptation planning and implementation to address this intersection of stressors, but that they desire a deeper engagement with the city via the use of fully collaborative, coproduction planning approaches.

Based on these findings, the NPCC3 report recommended to the city actions that would incorporate all forms of climate equity—distributional, contextual, and procedural—into its adaptation efforts, particularly if those efforts are focused at the neighborhood level. On the distributional dimension, the report recommended future tracking of social vulnerability through index-based methods like the social vulnerability index (SoVI (*SoVI® - College of Arts and Sciences | University of South Carolina*, n.d.) or SVI (*CDC/ATSDR Social Vulnerability Index (SVI)*, 2024)), through the use of individual variables, and/or through a combination of approaches. On the contextual dimension, the report recommended that the city involve local communities much earlier and more often in adaptation planning to ensure that local context and knowledge is appropriately accounted for in that planning. Additionally, the report also recommended that adaptation projects should contain a stronger focus on community development to reduce the potential of displacing longtime residents and to promote the social sustainability of local communities. For procedural equity, the report recommended that city officials work side by side with communities at the outset to co-design and co-implement neighborhood-based adaptation projects (Foster et al., 2019).

This Equity chapter builds on those findings and recommendations in the following ways. First, the chapter assesses the efforts of the city to incorporate equity into climate adaptation efforts since the NPCC3 report. It also describes how the communities profiled in that report have implemented and evolved their approaches to addressing the intersecting climate, environmental, and social stressors that they continue to face. Second, the chapter adds to the historical context of climate inequity in NYC by linking it to the bioregion's history of colonization, land dispossession, and slavery. The chapter importantly builds on an emerging body of empirical evidence demonstrating how historical and contemporary land use patterns and decisions shape present and future climate risks and social vulnerability, including climate displacement.

Third, to better respond to the ways that history shapes climate risks and social vulnerability for local communities, the chapter recommends a NYC-focused metric to identify areas of the city that are most vulnerable to the intersection of climate hazards, social vulnerability, and displacement. This scoring is utilized for multiple climate hazards in NYC and measures the sensitivity of certain populations to the intersection of various risks. Finally, the chapter highlights a number of practices and approaches to more equitable and just climate adaptation drawn from local, national, and international examples. These examples presuppose, based on the evidence gathered in the chapter, that in the absence of anti-displacement strategies in place, the city's resilience-promoting investments risk entrenching existing or creating new inequities by race, ethnicity, and income. As such, the chapter offers best practices that prioritize community-driven climate resilience approaches that are integrated, more equitable, and racially just.

1.3 Chapter Organization

This Chapter includes five substantive sections. Section 2 provides an overview of progress on climate equity goals since NPCC3 (Foster et al., 2019) including NYC's engagement with and adoption of equity considerations for climate-related initiatives across multiple City agencies and functions. The section also includes a review of community-led climate equity approaches for the three organizations who co-produced case studies featured in NPCC3 (Foster et al., 2019). Section 3 explores climate equity in the context of NYC's historical context from pre-colonial times to European colonization to present day and historic racialized land use practices. This section offers a framework for understanding the relationships between historic land use practices, climate risk, contemporary land use patterns, and social vulnerability. Section 4 reviews the emerging evidence and indicators of climate displacement and gentrification. This section also includes an approach for combining climate risks, social vulnerability, and displacement risk into a combined index for NYC. Section 5 offers a sample of best practices for equitable, racially just, climate adaptation from NYC and beyond. The case studies feature collaborative and intersectional approaches to climate adaptation by community-based climate justice organizations from NYC, the City's efforts in Edgemere, Queens, and the non-profit PUSH Buffalo in upstate New York.

2 Progress Toward Climate Equity in New York City Over the Past 5 Years

2.1 The City's Progress Toward Climate Equity Since NPCC3

In its last report, the NPCC made recommendations for the enhancement of equity in the City's climate adaptation planning, particularly at the neighborhood or community level (Foster et al., 2019). This section of the report will review NYC's engagement with equity in its climate-related work since the NPCC3 report was published in 2019, and specifically how the findings of NPCC3 have influenced the city's work in this area. Our methods include interviews with city officials and former city officials who have worked on climate change and equity efforts. We also reviewed numerous publicly available documents including executive orders, laws, policy and planning reports, and city-sponsored websites.

Prior to 2019, the City's equity-related climate change efforts largely focused on environmental justice (Foster et al., 2019). The NPCC3 report offered a framework for how the city might approach climate equity in its adaptation planning processes. The NPCC3 Equity Framework consists of three interrelated concepts: distributive equity, procedural equity, and contextual or recognitional equity. Contextual equity emphasizes the social, economic, and political factors and processes that contribute to uneven vulnerability and shape adaptive capacity (McDermott et al., 2013). Distributive equity emphasizes disparities across social groups, neighborhoods, and communities in vulnerability, adaptive capacity, and outcomes of adaptation actions (McDermott et al., 2013). Procedural equity emphasizes the extent and robustness of public and community participation in adaptation planning and decision making, such as community engagement during buyout processes (McDermott et al., 2013).

The assessment in this section reflects a review of online content, relevant reports, as well as semi-structured interviews with key informants with relevant knowledge of NYC's past and current equity strategies. Interviews were conducted between late 2022 and early 2023 using snowball sampling methods to recruit participants with knowledge of City initiatives, including representatives from the Mayor's Office of Climate and Environmental Justice (MOCEJ), the Mayor's Office for Economic Opportunity (NYC Opportunity) and the NYC Department of City Planning (Miles & Huberman, 1994).1 A total of five interviews were conducted using questions that focused on (1) approaches to environmental justice and equity within the context of climate adaptation planning, (2) programs and policies developed to address EJ and equity concerns, (3) awareness of the NPCC3 equity framework and whether it was incorporated into planning and decision-making process, and (4) challenges associated with implementation. These interviews were designed to explore current equity-related initiatives including PovertyNYC, EquityNYC, and the Comprehensive Waterfront Plan. The interviews were confidential, and the resulting summaries were member-checked as each interview participant reviewed them prior to inclusion in the report. Interviewees suggested that the NPCC3 equity framework and recommendations were well received by agency staff but applied unevenly across city agencies. Some reported not being aware of the framework, others consulted it but found it too technical/academic, only useful as background research or thinking, or not useful at all, while some agencies and offices consulted with it and used it to inform city plans/policies.

In general, the City's climate-related equity work since 2019 has become more explicitly focused on racial disparities. The theme of racial equity is especially prominent within NPCC4: Climate Assessment for New York City (Balk, Braneon, et al., 2024) and following the changed social and political context since 2019 (e.g., racial disparities in exposure and illness that were revealed by the COVID pandemic, racial justice awareness following the police murder of George Floyd in Minneapolis and the Black Lives Matter (BLM) movement). As such, this Report's discussion of climate-related equity efforts can be situated within a broader discussion of the City's increasing engagement with racial and social equity issues in other areas such as housing, policing, and public health.

Over the past five years, the City has embarked on four parallel and somewhat interrelated sets of actions to foster and advance equity:

(1) legislative and programmatic efforts addressing equity issues related to climate change impacts. These included adoption of several new local laws such as LLs 60 & 64 (Local Law 60, 2017; Local Law 64, 2017), which established the Environmental Justice Advisory Board, EJNYC Report, and EJ Mapping Tool (Environmental Justice Interagency Working Group, 2021), and EJNYC Plan (City of New York Mayor's Office of Climate & Environmental Justice, 2023), LL 78 (Local Law 78, 2021), which required the creation of a citywide equitable development data tool and racial equity reports for land use applications, and LL 122 (Local Law 122, 2021), which mandated a citywide climate adaptation plan;

(2) internal institutional reforms in the provision of city services (e.g., Executive Order 45 (City of New York Office of the Mayor, 2019b) which required the creation and tracking of social equity metrics and indicators);

(3) development of interactive digital and mapping platforms that are publicly accessible designed to track and monitor city agencies' progress (e.g., online Hazard Mitigation Plan (*Plan for Hazards - Hazard Mitigation - NYCEM*, n.d.), and Community Risk Assessment Dashboard (*CRA Dashboard – NYC Hazard Mitigation*, n.d.), EquityNYC (City of New York Mayor's Office for Economic Opportunity, 2023b), Equitable Development Explorer (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023));

(4) ongoing efforts to ensure equity in climate risk assessment and sustainability and resilience planning (e.g., NPCC4 (*New York City Panel on Climate Change (NPCC)*, n.d.), AdaptNYC (City of New York Mayor's Office of Climate & Environmental Justice, 2022a), Climate, Vulnerability, Impact and adaptation (VIA) Analysis (McPhearson et al., 2024), PlaNYC: Getting Sustainability Done (City of New York Office of the Mayor, 2023b).

Snowball or chain sampling involves utilizing well informed people to identify critical cases or informants who have a great deal of information about a phenomenon (Miles & Huberman, 1994)

2.1.1 Legislative and programmatic efforts addressing equity issues related to climate change impacts

As discussed in the introductory section, prior to the last NPCC3 report, the City was already committed to advancing equity with respect to addressing climate change impacts and developing place-based adaptation strategies, especially in the aftermath of Hurricane Sandy (2012). These efforts included initiatives such as *OneNYC: The Plan for a Strong and Just City* (City of New York Office of the Mayor, 2019a) the Resilient Neighborhoods studies (*Resilient Neighborhoods*, n.d.), and the Cool Neighborhoods (City of New York Mayor's Office of Resiliency, 2017) program. At the same time, environmental justice and social advocacy organizations had expressed that the City needed to do more for under-resourced groups and communities of color. This included more directly addressing the needs of vulnerable populations, improving community-based evacuation and disaster response, and supporting community-based resilience planning, specifically for neighborhoods adjacent to the Significant Maritime and Industrial Areas (SMIAs) (Bautista et al., 2016). Additionally, several EJ organizations and the New York City Council felt that the City's vision for coastal resilience, as previously laid out in the NYC Special Initiative for Rebuilding and Recovery (SIRR) plan, was too Manhattan-centric and did not account for unique challenges in each of the five boroughs and diverse communities across NYC, nor did it prepare them for the next superstorms (Iqbal, 2019; S. Maldonado, 2021; Sandy Regional Assembly, 2013).

In response, the City has increased efforts to understand community risk profiles, especially with a focus on historically disadvantaged and environmental justice communities. In particular, the City Council and local representatives from EJ organizations have emerged as key players in advancing and institutionalizing environmental justice and equity in the City's long-term climate adaptation planning efforts. Key legislations and activities adopted by the City Council that have resulted in the actions undertaken by the Mayor's Office, specifically MOCEJ, and other city agencies include:

- Local Law 60 required a comprehensive EJ report and Local Law 64 an EJ advisory board and an EJ interagency working group (Local Law 60, 2017; Local Law 64, 2017). These laws subsequently resulted in the establishment of the Environmental Justice Advisory Board (EJAB) and the convening of the Environmental Justice Interagency Working Group (EJ IWG) (City of New York Mayor's Office of Climate & Environmental Justice, 2023). Led by MOCEJ, EJ IWG is responsible for the development of the EJNYC report, the EJ Web-based Portal and Mapping Tool, and the EJNYC Plan. In December 2021, MOECJ and the EJ IWG released the Environmental Justice for All Scope of Work Report, which provided a roadmap for the development of the EJNYC report, mapping tool, and comprehensive plan (Environmental Justice Interagency Working Group (EJ IWG), 2021). These products are designed to systematically analyze EJ concerns citywide, to identify communities that are disproportionately impacted by environmental burdens and may not experience the benefits from green and climate resilient investments, and to inform city-level decision-making processes and programmatic initiatives that can advance climate and environmental justice.

- In 2020, the City Council released its own climate action agenda, Securing Our Future: Strategies for NYC in the Fight against Climate Change (New York City Council, 2020). This report included strategies for climate resiliency planning, GHG emission reduction, clean energy transition, waste reduction and circular economy, and workforce development for green jobs.

- Local Law 78 required a citywide equitable development data tool and racial equity reports for certain land use actions (Local Law 78, 2021). This legislation has resulted in the creation of the Equitable Development Data Explorer (EDDE) tool (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023) and a displacement risk map by the NYC Department of City Planning (DCP) and Department of Housing Preservation and Development (HPD) (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023). The EDDE is an interactive resource that provides analysis about the social, economic, and housing conditions in communities across NYC. The displacement risk map measures levels of displacement risk for neighborhoods citywide based on factors such as population vulnerability, housing conditions, and market pressure. This legislation also required Racial Equity Reports for certain land use actions, and applicants must include a study that analyzes the area's demographic conditions, quality of life, and displacement risk (ANHD, 2023). These initiatives sought to address growing concerns about gentrification and displacement linked to land use changes, rezonings, and real estate development trends that are happening in NYC.

- Local Law 122 mandated the creation of a citywide climate adaptation plan to protect every neighborhood from a wide range of hazards and prioritize the most vulnerable areas and EJ areas (Local Law 122, 2021). This legislation has resulted in the establishment of the AdaptNYC (City of New York Mayor's Office of Climate & Environmental Justice, 2022a) and Climate Strong Communities (City of New York Mayor's Office of Climate & Environmental Justice, 2022b) programs, both of which are overseen by MOCEJ. AdaptNYC is an online program that identifies climate change hazards that pose the greatest threats, populations and neighborhoods

that are most at risk, and the adaptation and resiliency measures that the City is currently taking to protect residents, property, and infrastructure. Climate Strong Communities is a neighborhood-based resiliency and sustainability planning program in which MOCEJ identifies vulnerable communities and engages local stakeholders to implement infrastructure and other measures that address adaptation needs. MOCEJ has already started working with communities in Brownsville and Canarsie, Brooklyn; Corona, Queens; East Harlem, Manhattan; Port Richmond, Staten Island; and Soundview, the Bronx (City of New York Office of the Mayor, 2023b).

2.1.2 Fostering internal institutional reforms to advance racial equity and social justice

In the past few years, the City has increased efforts to advance racial equity and social justice within city agencies. In 2018, NYC joined the Government Alliance for Racial Equity (GARE), a network of municipal governments that provides strategies for combating racism and promoting racial equity within city governments (Government Alliance on Race and Equity, 2023). Staff from then Mayor de Blasio's Office of Climate Resiliency (predecessor to MOCEJ) employed GARE's Racial Equity Assessment Tools, a step-by-step analysis of equity goals, stakeholder and community engagement, and outcomes (Office of Climate Resiliency, personal communication, December 2, 2022). The tool also provided staff members with relevant language to discuss environmental and climate justice issues. City staff consulted with and received feedback from other municipal government representatives to better understand how racial equity can be operationalized within the city. Highly motivated staff members formed an internal Equity Work Team, which functioned as a centralized think-tank for developing racial equity policy, fostering internal changes, building institutional capacity and mechanisms for hiring people, soliciting buy-in and feedback from leadership, promoting horizontal collaboration, and breaking down bureaucratic silos. These efforts culminated, in part, in the creation of an anti-racism city charter, hiring protocols that address racial justice, and the incorporation of environmental justice and racial justice into the fabric of the city's work (Office of Climate Resiliency, personal communication, December 2, 2022).

In 2019, Mayor de Blasio signed Executive Order 45 (EO45) (City of New York Office of the Mayor, 2019b, p. 45), which mandated the annual creation of the Social and Equity Indicators Report by the Mayor's Office for Economic Opportunity (now referred to as NYC Opportunity) (City of New York Mayor's Office for Economic Opportunity, 2023b; Executive Order 45, 2019). The report, which exists as an interactive digital platform EquityNYC, is intended to measure the social, economic, and environmental health of the city. It analyzes equity outcomes in eight policy domains including: (1) core infrastructure and environment, (2) diverse and inclusive government, (3) economic security and mobility, (4) education, (5) empowered residents and neighborhoods, (6) health and well-being, (7) housing, and (8) personal and community safety. It also includes standardized equity metrics that measure city agencies' work through equity lens such as (1) city services, (2) service locations, (3) workforce diversity, (4) M/WBE contract distribution, and (5) internal equity practices. Data for equity outcomes and standardized equity metrics must be collected, analyzed and disaggregated by race/ethnicity, gender identity, income, and, where available, sexual orientation. The dataset for EquityNYC is publicly available through NYC Open Data (City of New York Mayor's Office for Economic Opportunity, 2023b).

Additionally, as part of EO45, staff members from Mayor's Office of Climate Resiliency participated in a 9-month training program hosted by the Mayor's Office of Operations to learn how to institutionalize Results-Based Accountability (RBA) and incorporate racial and social equity principles into long-term strategic planning processes within the agency and with communities (Mayor's Office of Climate and Environmental Justice (MOCEJ), personal communication, July 27, 2023). This effort helped conceptualize the early development of the Climate Strong Communities initiative (City of New York Mayor's Office of Climate & Environmental Justice, 2022b).

In the past year, NYC Opportunity has developed a series of mapping platforms that help the public visualize distribution of equity outcomes, city services, and city service locations (City of New York Mayor's Office for Economic Opportunity, 2023b). The office continues to partner with city agencies to routinely collect data on service programs, examine equity strategies, and develop new programs and policies that aim to reduce service disparities (Office for Economic Opportunity, personal communication, January 5, 2023, p. 4). Since 2020, over 40 city agencies (City of New York Mayor's Office for Economic Opportunity, 2023b) have completed an annual online survey (City of New York Mayor's Office for Economic Opportunity, 2023b) that inventories internal equity practices such as formation of working groups to reduce social and racial inequality, specialized training on equity-related concepts and skills, strategies to promote equitable hiring processes, training and mentorship programs to support career advancement for individuals from traditionally underrepresented groups, and contracting with equity consultants or third party vendors to support social and racial equity work (City of New York Mayor's Office for Economic Opportunity, 2023a). These EquityNYC-related initiatives represent a concerted effort to provide transparency and accountability about the City's equity work, which is key for addressing service disparities and tailoring policy responses (Office for Economic Opportunity, personal communication, January 5, 2023, p. 4).

Other city-level agencies and entities have also developed initiatives to promote internal reforms and racial equity. In 2020, the Department of Health and Mental Hygiene (DOHMH) released the Race to Justice Action Kit (City of New York Department of Health and Mental Hygiene, 2023), an initiative that evolved from earlier efforts started in 2016(Human Impact Partners, 2019) to address racism in healthcare. The Race to Justice Action Kit provides an overview of the effects of racism on historical and contemporary health, communication tips for staff, a language use guide, and a community engagement framework. Additionally, with strong support from DOHMH, in 2021, the NYC Board of Health adopted a resolution to declare racism a public health crisis (City of New York Department of Health and Mental Hygiene, 2021a). Furthermore, in 2020, the NYC Commission on Human Rights released a report on "Black New Yorkers on Their Experiences of Antiblack Racism," which included recommended strategies for internal and structural reforms and for advancing racial equity among city agencies and offices (City of New York Commission on Human Rights, 2019). In spring 2022, Mayor Eric Adams created the Mayor's Office of Equity, which oversees multiple equity-related offices and commissions including the Commission on Gender Equity, the Racial Justice Commission, the Pay Equity Cabinet, the Unity Project, the Young Men's initiative, and the Taskforce on Racial Inclusion and Equity (City of New York Mayor's Office of Equity, 2023).

In the latest NYC Comprehensive Waterfront Plan (CWP) (City of New York Department of City Planning, 2021b), language relating to equity, racial justice, environmental justice, and climate justice was consistently deployed (City of New York Department of City Planning, 2021b; Office of Climate Resiliency, personal communication, January 12, 2023). In the previous version developed under Bloomberg (i.e., Vision 2020 (City of New York Department of City Planning, 2011), these terms did not make a single appearance. In the current CWP (City of New York Department of City Planning, 2021b), equity is conveyed as one of the three guiding values and climate justice as the driving principle (City of New York Department of City Planning, 2021b). The CWP explicitly recognizes the historical legacy of structural racism, marginalization, discrimination, and economic inequality, as well as the disproportionate impacts of climate change on low-income communities and communities of color. It also features examples of initiatives related to just transition (e.g., Edgemere Community Land Trust, Sunset Park Solar) and includes language expressing commitments to racial equity (City of New York Department of City Planning, 2021b). The usage of these terms, particularly references to racial inequity and injustice, represents a shift in the City's approach to addressing equity and climate change. In another example, the NPCC3's climate equity framework was applied to inform the development of MOCEJ's Neighborhood Coastal Protection Planning Guidance, which provides best practices for siting of city-level capital coastal protection projects (City of New York Mayor's Office of Climate Resiliency, 2021).

2.1.3 Development of indicators and metrics to track progress on equity and digital and interactive mapping platforms to foster transparency and accountability

Over the past decade, the City, specifically through NYC Opportunity, has increased efforts to track and monitor progress on reducing poverty rates as well as spatial and socio-demographic disparities in city-funded provisions. NYC Opportunity leads multiple initiatives to develop indicators and metrics for social and racial equity (described in the section above) (*Social Indicators Report - NYC Opportunity*, n.d.) and performance measures for poverty reduction (*Poverty Measure - NYC Opportunity*, n.d.) and equitable workforce development (*Workforce Data Portal*, n.d.) See Table 1: Indicators and Metrics for City-Funded Provisions. Performance measures are designed to assess outcomes of specific policy interventions, for example, to determine the effects of anti-poverty initiatives (e.g., tax credit programs, food stamps, nutritional assistance programs) on poverty rates or who benefits from city-sponsored career development and employment services. To provide users with a more complete picture of city-provided activities, NYC Opportunity routinely collects data from city agencies and partner organizations, which can date back to the year 2000 and up to the present, and disaggregates them by race/ethnicity, gender, and income. Data on social and racial equity and workforce development, along with data stories and related programs, are accessible through online platforms and digital navigators such as EquityNYC (City of New York Mayor's Office for Economic Opportunity, 2023b), Workforce Data Portal (*Workforce Data Portal*, n.d.), Jobs NYC (*Jobs NYC*, n.d.), and AccessNYC (*ACCESS NYC*, n.d.).

Table 1: Indicators and Metrics for City-Funded Provisions

Details		Agency	Sources
Social Equity Indicators	NYC Opportunity	https://www.nyc.gov/site/opportunity/reports/social-indicators-report.page	
Poverty Measures	NYC Opportunity	https://www.nyc.gov/site/opportunity/poverty-in-nyc/poverty-measure.page	
Workforce Metrics	NYC Opportunity	https://workforcedata.nyc.gov/en	

The development of publicly accessible online platforms is part of a larger effort across city agencies to communicate progress and activities on the external facing side (Office for Economic Opportunity, personal communication, January 5, 2023, p. 4). These new tools are intended to build a culture of transparency and accountability and employed to justify the City's decisions to address social, economic and health disparities in underserved areas (Office for Economic Opportunity, personal communication, December 8, 2022, p. 2). In recent years, city agencies have created multiple tools to visualize data on population, land use and zoning, and environmental risks and vulnerability, and data sources for many of these tools are available for download on NYC Open Data (City of New York, 2022, see Table 2).

Specifically, there has been an increase in spatial visualization platforms designed to promote and/or enhance planning at the community or neighborhood level. City agencies and community-based organizations can find community-level data on demographic information, land use, and flood and heat vulnerability. They can also compare distributions of city services, facilities, zoning applications, broadband access, and mitigation and resilience projects among the City's 59 community districts.

To integrate environmental justice concerns into citywide spatial planning, MOCEJ, in collaboration with EJAB and EJ IWG, is set to release a public, web-based portal and mapping tool detailing environmental and climate data; this action is a direct result of the passage of Local Law 60 and 64 in 2017 (Local Law 60, 2017; Local Law 64, 2017). To address growing community concerns regarding housing development and displacement risks, the NYC DCP and HPD created the Equitable Development Data Explorer (EDDE) (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023) as a response to Local Law 78 in 2021 (Local Law 78, 2021). The EDDE provides analysis of the demographic, social, economic, and housing conditions along with displacement risks for NYC communities and can be used for community advocacy purposes and/or inform planning decisions on affordable housing, capital investments, and land use. To complement the EDDE, DCP also developed two interactive platforms that examined the dynamics of racial/Hispanic composition (City of New York Department of City Planning, 2021a) and stability and change in NYC neighborhoods (City of New York Department of City Planning, 2023b). The creation of an EJ mapping tool, the EDDE, and other neighborhood-based visualization tools is consistent with growing nationwide recognition of the need to address historic inequities in the most at-risk communities. NYC-level data can be cross-referenced with other relevant spatial data visualization tools such as the US Environmental Protection Agency's Environmental Justice Screening Tool (US EPA, 2014) and the national Climate and Economic Justice Screening Tool (Executive Office of the President of the United States Council on Environmental Quality, 2023).

In addition, an increasing number of policy and planning documents are available online in digital and interactive formats that can be changed and updated over time, with some functioning as "living" documents rather than static ones. Examples include the NYC Hazard Mitigation Plan (City of New York Office of Emergency Management, 2019), the 2021 Comprehensive Waterfront Plan (City of New York Department of City Planning, 2021b), EquityNYC (City of New York Mayor's Office for Economic Opportunity, 2023b), AdaptNYC (City of New York Mayor's Office of Climate & Environmental Justice, 2022a), and OneNYC 2050 (City of New York Office of the Mayor, 2023a).

Table 2: Visualization mapping platforms encompass multiple categories including demographic data, land use, hazard risks and vulnerability, and other.

Category	Description of web-based visualization platforms	Name	Agency	Website
Population	City-level census data	Population Factfinder	NYC DCP	https://popfactfinder.planning.nyc.gov/#12.25/40.724/-73.9868
	Community-based socio-demographic data	Community District Profiles	NYC DCP	https://communityprofiles.planning.nyc.gov/
	Environmental Justice	Environmental Justice Areas	MOCEJ	https://nycdohmh.maps.arcgis.com/apps/instant/lookup/index.html?appid=fc9a0dc8b7564148b4079d294498a3cf
	Neighborhood composition	Dynamics of Racial/Hispanic Composition in NYC Neighborhoods (2010-2020)	NYC DCP	https://storymaps.arcgis.com/stories/46a91a58447d4024afd00771eec1dd23
		Stability & Change in NYC Neighborhoods (2010-2020)	NYC DCP	https://storymaps.arcgis.com/stories/c7bf9175168f4a2aa25980cf31992342
Land Use and Zoning	Land use	ZoLa (Zoning & Land Use)	NYC DCP	https://zola.planning.nyc.gov/about/
	City-based facilities	NYC Capital Planning Explorer	NYC DCP	https://capitalplanning.nyc.gov/facilities/
	Zoning applications	Zoning Application Portal	NYC DCP	https://zap.planning.nyc.gov/projects
	Development planning	Equitable Development Data Explorer	NYC DCP & HPD	https://equitableexplorer.planning.nyc.gov/map/data/district
		Displacement Risk Map	NYC DCP & HPD	https://equitableexplorer.planning.nyc.gov/map/drm/nta https://equitableexplorer.planning.nyc.gov/map/drm/ntac
Environmental Risk and Vulnerability	Flood vulnerability	NYC Flood Hazard Mapper	NYC DCP	https://dcp.maps.arcgis.com/apps/webappviewer/index.html?id=1c37d271fba14163bbb520517153d6d5
	Heat vulnerability	NYC Heat Vulnerability Index	NYC DOHMH	https://a816-dohbesp.nyc.gov/IndicatorPublic/beta/key-topics/climatehealth/hvi/
	Emergency preparedness	NYC Hurricane Evacuation Zone Finder	NYCEM	https://maps.nyc.gov/hurricane/#
	Mitigation and resilience projects	NYC Mitigation Actions Map	NYCEM	https://nychazardmitigation.com/documentation/mitigation/actions/
	Community-level hazard risks	Community Risk Assessment Dashboard	NYCEM	https://cra.nychazardmitigation.com/
	Community resources for hazard mitigation	Community Hazard Mitigation Resources	NYCEM	https://nychazardmitigation.com/documentation/community/
Other	City-funded services and provisions	EquityNYC	NYC Opportunity	https://equity.nyc.gov/
	Broadband access for NYCHA residents	NYC Big Apple Connect	NYC OTI	https://www.nyc.gov/assets/bigappleconnect/

2.1.4 Ongoing efforts to incorporate equity in climate risk assessments and in sustainability and resilience planning

The City continues to incorporate equity in ongoing efforts to conduct climate risk assessments (e.g., Climate Vulnerability, Impact, and Adaptation Analysis project) and in sustainability and resilience planning (e.g., PlaNYC: Getting Sustainability Done). At present, MOCEJ is currently sponsoring the Climate Vulnerability, Impact, and Adaptation Analysis (VIA) study (McPhearson et al., 2024), an 18-month interdisciplinary initiative to develop a comprehensive analysis of future potential climatic conditions and associated socio-economic impacts in NYC. VIA-related projects include (1) high-resolution climate projections for heat risk and exposure, storm surge, and coastal flooding, (2) characterizing current and future extreme heavy rainfall, (3) systematic assessment of health-related economic costs from climate sensitive events, and (4) a creation of a Flood Vulnerability Index to identify areas with the highest vulnerability to coastal storm surge, tidal, and pluvial flooding. The VIA research has the potential to advance equity by providing key information and tracking tools on populations facing the brunt of climate impacts now and in the future. Together with the EJNYC report, the VIA research will also inform other efforts to develop forward-looking adaptation strategies and plans that prioritize vulnerable populations and EJ areas.

In April 2023, the City, led by the Adams administration, unveiled its latest vision for sustainability and resiliency called PlaNYC: Getting Sustainability Done (City of New York Office of the Mayor, 2023b). This plan functions as an update and successor to de Blasio's OneNYC: A Strong and Just City (City of New York, 2015). Building on the previous administration's focus on equity, the new sustainability plan centers environmental justice and health equity as core components for near-term and long-range climate action planning. It proposes multiple climate resiliency initiatives that prioritize vulnerable populations (e.g., NYCHA residents, low-income and moderate-income households, basement apartment dwellers) and environmental justice communities. Example initiatives include piloting Resilience Hubs in areas that are exposed to flood- and storm-related hazards and across NYCHA campuses and Cool Corridors in areas that are disproportionally affected by the urban heat island effect with a focus on environmental justice communities (City of New York Office of the Mayor, 2023b). Others include the Climate Strong Communities program designed to identify climate resilience investments in communities that were left out by Hurricane Sandy recovery funding and the FloodHelpNY and the HomeFix programs to help low- and moderate-income homeowners with acquiring flood insurance coverage, repairs, and resilience retrofits (Center for NYC Neighborhoods, n.d.; City of New York Department of Housing Preservation and Development, 2024; City of New York Mayor's Office of Climate & Environmental Justice, 2022b). The plan also addresses equity in terms of access to sustainability and green economy investments by prioritizing historically underserved communities. Example initiatives include creation of multi-purpose green infrastructure (e.g., nature-based stormwater management solutions, greenways, greenspace), bike lanes, urban farms and community gardens, community brownfield planning grants, electrification and efficiency upgrades for NYCHA housing, and workforce development and training for green and circular economy sectors.

In combination with municipal capital spending, the City is counting on new federal and state funding streams to develop and implement its sustainability and resiliency initiatives (City of New York Office of the Mayor, 2023b). The latest PlaNYC outlines ambitious strategies for leveraging these sources of funding, which include the Bipartisan Infrastructure Investment and Jobs Act (IIJA), the Inflation Reduction Act (IRA), the New York State (NYS) Environmental Bond Act as well as from other sources such as the Federal Healthy Street Programs, Federal Emergency Management Agency (FEMA)'s Building Resilience Infrastructure and Communities (BRIC) program and Pre-Disaster Hazard Mitigation Assistance program, and other grants from federal and state agencies (City of New York Office of the Mayor, 2023b). The City is pursuing federal and state funding to implement efforts including the Climate Strong Communities program, Resilience Hubs, Cool Corridors, stormwater management projects, clean energy projects, municipal fleet electrification, green workforce training, and other climate and environmental projects. It has recently called on the federal government to provide $8.5 billion in pre-disaster mitigation funding to implement unfunded resiliency projects (*Mayor Adams Commemorates 10th Anniversary of Superstorm Sandy*, 2022). In terms of advancing equity, grants and programs funded by the IIJA and IRA are subjected to the Justice40 initiative, an provision inspired by and similar to the environmental justice provision in the NYS' Climate Leadership and Community Protection Act (CLCPA) (New York State Climate Leadership and Community Protection Act, 2019), requiring that "40 percent of overall benefits of certain federal investments flow to disadvantaged communities that are marginalized, underserved, and overburdened by pollution" (The White House, 2022, p. 40). Tracking how the CLCPA's EJ provision (New York State Climate Leadership and Community Protection Act, 2019) and the Justice40 initiative (The White House, 2022, p. 40) are implemented and how climate investments are distributed at local and neighborhood levels requires further research.

While the City has developed numerous plans, policies, and programs to advance equity in climate adaptation planning, efforts to track and monitor equity issues with respect to climate resilience investments are in early stages. Existing efforts include the Sandy Funding Tracker (City of New York Office of Emergency Management, 2023b) and the NYC Emergency Management (NYCEM)'s Mitigation Actions Map (*Actions Map – NYC Hazard Mitigation*, n.d.),

but these tools do not provide a complete picture of the City's spending on climate resilience or on the status of completed and planned projects. For example, while the Sandy Funding Tracker provides information about how much federal grant money has been spent, it does not include the status or anticipated completion dates for federally funded projects nor include information about the City's capital contributions to these projects (Yeung & Levers, 2022). On the other hand, while NYCEM's Mitigation Actions Map conveys the status and location of the City's capital investments in hazard mitigation projects, without a clear picture of community-specific strategies for climate risks and vulnerability, it remains difficult to determine whether local adaptation needs are being met. It may be noted though that, at the least, the NYCEM's Climate Risk Assessment Dashboard (City of New York Office of Emergency Management, 2023a) includes a Risk Report feature for each neighborhood, assisting in understanding local adaptation needs and providing information on community programmatic resources. Efforts to develop community-level climate risk assessment and resilience strategies such as the US Army Corps of Engineers (USACE)'s NY & NJ Harbor & Tributaries Coastal Storm Risk Management Study (NYNJHATS), the VIA project, and the Climate Strong Communities are only now underway. In the Ten Years after Sandy: Barriers to Resilience report (Yeung & Levers, 2022), the New York City Office of the Comptroller found that as of June 2022, the City has only spent 73 percent of the $15 billion of federally appropriated grants for Sandy recovery and resilience (Yeung & Levers, 2022). Slow progress can be attributed to complexity of projects, lengthy coordination and approval requirements by federal agencies, and challenges associated with community engagement (S. Maldonado, 2022).The Comptroller office recommended that the City accelerates the pace of resiliency spending and improve public transparency of capital project tracking, particularly by establishing the Capital Project Tracker that provides accessible neighborhood-level information about resiliency projects with details such as budgets, timelines, and management entities (Yeung & Levers, 2022). The City established the NYC Capital Projects Dashboard in 2023 in response to the Comptroller's recommendation (City of New York Mayor's Office of Operations, 2024).

In the last few years, MOCEJ has increased efforts to communicate the City's progress on climate action in clearer and more accessible manners. Its website has been updated and streamlined to convey information about climate hazards and ongoing work on climate change adaptation, sustainability, and environmental justice. The agency recently created a webpage (City of New York Mayor's Office of Climate & Environmental Justice, 2022c) that compiles key coastal infrastructure studies and projects that are taking place across five boroughs. While Manhattan is home to many large-scale projects funded by federal post-Sandy recovery and rebuilding grants (e.g., the East Side Coastal Resiliency project, the Battery Coastal Resilience Project, the Battery Park City Resilience projects, the Brooklyn –Bridge-Montgomery Coastal Resiliency project), others such as the Interim Flood Protection Measures Program (IFPM), Living Breakwaters, Raised Shorelines, Red Hook Coastal Resiliency, and other USACE-led resiliency projects are being implemented in other boroughs.

Another mechanism that can potentially enable transparent tracking of sustainability and resiliency funding and spending is the climate budgeting initiative (Khan & Adams, 2023). Together with the City of London, New York is among the first to adopt a systematic approach "that incorporates science-based climate considerations into the budget decision-making process by evaluating how actions and spending today contribute to meeting longer-term climate targets" (City of New York Office of the Mayor, 2023b; Khan & Adams, 2023). The initiative is led by the Mayor's Office of Budget and Management (OMB)'s Environmental Sustainability and Resiliency Taskforce in partnership with MOCEJ, who are working to include resilience, sustainability, and equity indicators when reviewing budget proposals from city agencies. Information about the process will be documented in an annual publication, to be released in April 2024, which highlights the City's investments and provides a snapshot of progress on meeting long-term climate goals (City of New York Office of the Mayor, 2023b).

2.1.5 Remaining equity concerns

Since the publication of the NPCC3 report in 2019, the City's framing of equity has broadened from initially focusing on environmental justice to later including racial justice and climate justice. There has also been a shift in usage of language and concepts about equity in planning discussions. City-level efforts aimed to address the institutional foundation for advancing social and racial equity, starting with an explicit recognition of the legacy and persistent effects of structural racism on health, income, and access to services as a first step to operationalizing racial equity and social justice. The development of digital visualization tools and mapping platforms, as well as making city-level data more accessible and available, enables city agencies to better communicate progress and foster a culture of transparency and accountability (and thus trust) with the public. Recently adoption of laws such as LLs 60 & 64 in 2017 and LL 78 &122 in 2021 (Local Law 60, 2017; Local Law 64, 2017; Local Law 78, 2021; Local Law 122, 2021) ensures that consideration for environmental justice and equity in climate adaptation planning efforts will be key

priorities for subsequent mayoral administrations and that these priorities will continue beyond the usual political cycles.

At the same time, several key equity concerns remain:

- The City has numerous initiatives to assess and characterize climate risks including the SIRR initiative (City of New York Office of the Mayor, 2013), Heat Vulnerability Index (City of New York Department of Health and Mental Hygiene, 2022a), Flood Hazard Mapper (City of New York, 2023a), Comprehensive Waterfront Plan (City of New York Department of City Planning, 2021b), and Community Risk Assessment Dashboard (*CRA Dashboard – NYC Hazard Mitigation*, n.d.) but there is a need to develop more adaptation strategies and plans that reflect the unique context and address challenges of each of the five boroughs, 59 community districts, and/or specific neighborhoods. To date, the Resilient Neighborhood studies (*Resilient Neighborhoods*, n.d.), Cool Neighborhoods NYC (City of New York Mayor's Office of Resiliency, 2017), Lower Manhattan Coastal Resilience Projects (*Lower Manhattan Coastal Resiliency (LMCR)*, n.d.), and the Resilient Edgemere Community Plan (City of New York Department of Housing Preservation and Development, 2017) are among the few city-sponsored community-based adaptation plans. While Climate Strong Communities initiative is designed to address local equity and adaptation concerns, it is in the early stages of implementation. A better understanding of how specific climate risks (e.g., flooding, heat) affect individual communities and neighborhoods will allow the City to tailor policy responses and resource allocation, develop mechanisms for soliciting inputs and buy-in, and document benefits and outcomes.

- As the City works with state and federal agencies to develop climate adaptation and resilience projects, there is a need to systematically document and track climate investments to ensure communities are prioritized equitably and their adaptation needs are met. The Sandy Funding Tracker,(City of New York Office of Emergency Management, 2023b) NYCEM's Mitigation Actions Maps,(*Actions Map – NYC Hazard Mitigation*, n.d.) and the Comptroller's Climate Dashboard are web-based platforms that allow users to see what and where climate investments are sited. City agencies need to assess equity impacts of climate investments, particularly the effects of these investments on existing social, economic, and housing conditions in neighborhoods and ensure that new projects reflect local stakeholders' goals, visions, and desires. City-sponsored adaptation projects should be developed in synergy with existing community-led planning efforts, particularly those by local EJ and community advocacy organizations, to ensure concrete community benefits and equitable outcomes. The work by OMB and MOECJ on climate budgeting can ensure transparency and equity when tracking climate investment spending. In response to the Comptroller's recommendation, the City developed the NYC Capital Project Dashboard (City of New York Mayor's Office of Operations, 2024) to monitor how resiliency is being integrated into capital projects (Yeung & Levers, 2022). Further research is needed to understand how city agencies and land use applicants comply with Local Law 78 (Local Law 78, 2021), which requires racial equity reports for certain land use actions, and whether this regulation results in meaningful outcomes for communities facing displacement risks.

- Through the EquityNYC initiative, the City has developed robust equity metrics and indicators that capture multiple dimensions of governance, but this effort is largely focused on disparities in city-funded services (i.e., distributive equity) (City of New York Mayor's Office for Economic Opportunity, 2023b). Development of indicators and metrics that can capture other dimensions of equity such as procedural or contextual equity is a more difficult task. It will require further research and consultation with local stakeholders to ensure that city-level datasets reflect on-the-ground reality and service disparities have improved. Similarly, future efforts to track equity progress and visualize spatial data should include a public and/or community engagement component. On the other hand, limited efforts exist in developing equity indicators and metrics regarding climate adaptation and resilience planning. The City, specifically city agencies such as MOCEJ, DCP, NYCEM, and NYC Opportunity along with NPCC, can expand upon the EquityNYC initiative and NPCC3's New York City Climate Change Indicators and Monitoring Systems (NYCLIM) framework (Blake et al., 2019; City of New York Mayor's Office for Economic Opportunity, 2023b) and develop community-specific indicators and indices that can capture dimensions such as social and health vulnerability, disparate exposure, adaptive capacity, mobility, and housing. Available resources for consultation include the City of San Diego's Climate Equity Index and the City of Cincinnati's Climate Equity Indicators for Neighborhoods (City of San Diego Sustainability Department, 2019; Even et al., 2021).

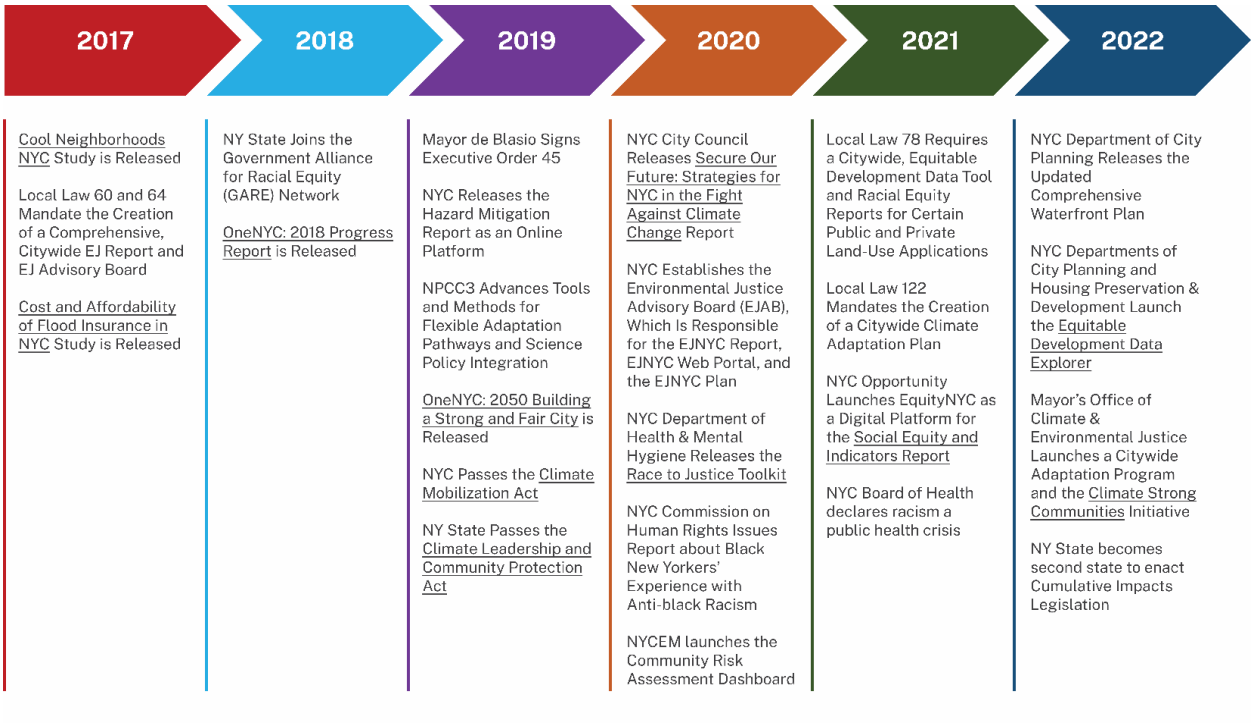

Figure 1: Timeline of City's climate-related equity actions.

2.2 Community-level Action and Progress Toward Climate Equity

The NPCC3 Chapter: Community-Based Assessments of Adaptation and Equity (2019) featured three case studies co-produced with environmental justice organizations, including WEACT for Environmental Justice in northern Manhattan; UPROSE in Sunset Park, Brooklyn; and The Point CDC in Hunts Point, in the Bronx. These case studies included a review of environmental, climate, and social stressors as well as climate action plans developed by these groups. In NPCC3 (2019) Chapter on Equity, section 6.5.1 *Community-based adaptation initiatives and projects*, a review of each organization's climate adaptation projects and their approach to community engagement were summarized. Since the release of NPCC3, these communities have continued to both implement and evolve their approaches to climate, environmental and social stressors. The impact of the COVID-19 pandemic on communities represented by these organizations and increasing climate change-related extreme weather events like Hurricane Ida have also required dynamic approaches to meet the needs of their respective communities.

Table 3 summarizes updates to some of the climate-related projects that were featured in NPCC3.

The updates reflect a review of each organization's website and other online sources, as well as information from semi-structured interviews conducted with Sonal Jessel (Director of Policy) from We Act and Elizabeth Yeampierre (Executive Director), and John Fleming (Development Director/Project Manager) of UpRose. We were unable to reach The Point CDC for interviews, thus updates reflect the information found online.

Table 3: Climate-Related Projects Featured in NPCC3

Cases	Updates from NPCC3 Projects
UPROSE, Sunset Park Brooklyn	■ Climate Justice Youth Summit was last held in 2019 and then paused due to Covid. UPROSE continues to organize youth and intergenerational groups of residents in "Learning Circles" that entail climate adaptation discussions. ■ Block Captains, a program that trains volunteers to contribute to resilience work in the Sunset Park neighborhood, was put on hold and shifted to a campaign focused on land use proposals for Industry City. ■ The Sunset Park Climate Justice Center hosted town hall meetings to facilitate community-based resiliency planning with residents. Participants gave input on climate adaptation measures that can also combat displacement and reflect just transition opportunities for local wealth creation. ■ Sunset Park Solar is a 685-kilowatt solar project to be built on the Brooklyn Army Terminal rooftop. The cooperative will include 200 community solar subscribers who receive 15% savings on their monthly energy bills. Project construction was delayed due to the pandemic but leasing and financing agreements are being finalized and construction is expected to begin this year.
WE ACT	■ Northern Manhattan Climate Action Plan (NMCA) is a community-informed agenda for addressing climate change in northern Manhattan, with strong energy democracy principles. The plan targets publicly owned power, renewable energy generation, sustainable housing, and a resilient built environment. ■ Solar Uptown Now (SUN) project is now complete, with 415 KW of installed solar on Housing Development Fund Corporation (HDFC) co-operatives in northern Manhattan. ■ Community Solar project installed solar on three NYCHA buildings and trained over 100 NYCHA residents in solar installation. ■ The NYCHA Villages report (de Hoz & Abreu, 2019) was issued by WeAct on *Healthy and Sustainable Public Housing. The report* addresses issues of mold, maintenance defects, pests, and power outages. This led NYDEC to fund the Inwood Climate Change & Health Project which expanded beyond Dyckman Houses to look at climate change and health initiatives throughout the Inwood neighborhood.
The Point CDC	The Point CDC was a project partner for *Hunts Point Lifelines*, a proposal funded by US HUD's Rebuild by Design program after Hurricane Sandy. Although the City convened a working group to solicit community input, residents raised concerns about limited input and the risk of displacement of proposed resiliency efforts (Foster et al., 2019). A 2020 Hunts Point Resiliency Feasibility study of the proposal recommended the energy components be considered for implementation, while issues like coastal flooding be deferred for future implementation ((NYCEDC, 2020). FEMA announced NYC EDC was a recipient of BRIC funding to dry floodproof two food facilities at Hunts Point that are most at risk of storm surge flooding (FEMA, 2022). The Point CDC was a member of the Hunts Point Forward Working Group, which supported development of the engagement process, recommendations, and implementation pathways for the Hunts Point Forward plan (NYCEDC, 2023) part of the City's $140 million investment in Hunts Point infrastructure. The Hunts Point Forward plan builds from EDC's first neighborhood-wide plan for the area, the 2004 Hunts Point Vision Plan .

3 Climate Equity in the Context of NYC's Historical Experience

3.1 Historical Dispossession of Land and Land Uses

The climate change challenges we currently face in NYC are inextricably linked to the bioregion's (see BOX 1) history of settler colonialism, extractivism, imperial trade, and slavery (The Public History Project, 2023). An understanding of this historical context is essential for formulating effective policies that address the rapidly changing climate. In addition, local Indigenous knowledge provides valuable ecosystemic insights that can help us all move toward

repairing the broken human-environment relationship. Urban agriculture, land stewardship, and community gardens are three promising examples illustrating urban processes of relinking to nature.

BOX 1. The Great Tidal Ecoregion

The Algonquian term for what British colonialists boasted as the "Hudson River" is *Mahicannituk*^{w} or "great tidal river." This "ecoregion", roughly the NYC metropolitan region, has been a thriving place where land, sea, and rivers converge. Compressed herein is an elaborate estuary in a relatively small area fostering thriving life energies.

At the southernmost boundary of the Wisconsin ice sheet of 20,000 years ago, this "end moraine" left a ridge elevation of mineral soil, gravel, sand, silt, and clay amidst a saltwater / freshwater habitat for shellfish, waterfowl, migrating fish, and Lunaape (Lenape) with allied Algonquian communities.

Upland forests, rich in nut bearing trees, provided additional food and shelter; and selective burning sustained forests and grasslands that extended the palette of plants and creatures used for dietary, cultural, and medicinal uses. This tending of native flora and fauna created a dynamic seasonal natural economy.

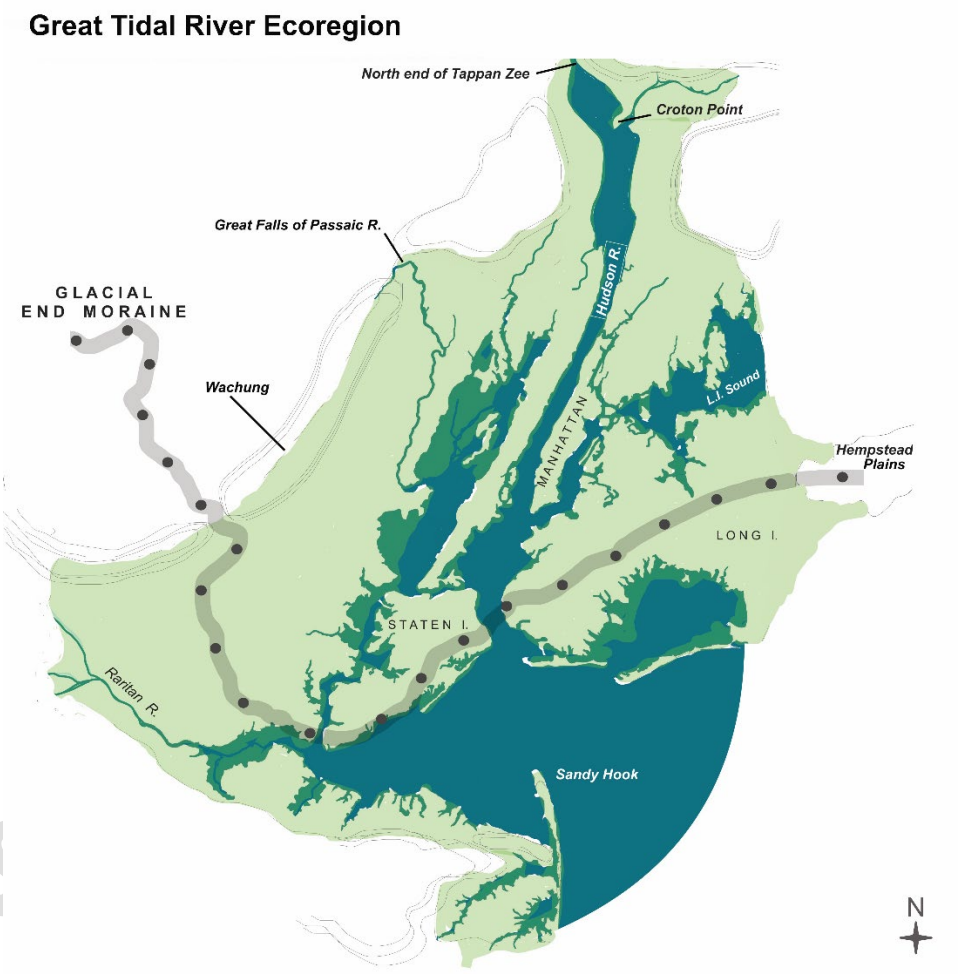

Figure 2: The Great Tidal Ecoregion. Courtesy of Kerry Hardy and the Public History Project

Dutch and British colonizers intent on maximizing their profits in local and global markets, took limited regard for the local ecosystems. By 1750, Dutch naturalist Pehr Kalm remarked how the forests of New Jersey were "already more ruined than any others." (Kalm, 1770, p. 50)

Well before industrial pollution, this attitude of endless "natural resource" extraction disrupted the regenerative and sustainable local cycle of tending, what Indigenous ethnobotanist Robin Wall Kimmerer frames as the tradition of the "honorable harvest" of "take only what you need and use everything you take." (Kimmerer, 2013, pp. 148, 179)

With recent IPCC acknowledgment of both Indigenous Local Knowledge (ILK) and Traditional Ecological Knowledge (TEK) it is increasingly possible to have a mutually respectful dialogue on how a dynamic ecology might be better balanced within the NY metro ecoregion within the larger bioregion.[2] Notably, NYC Greenmarkets interlinking local small farmers with NYC Parks, cobbled together by Robert Lewis over three decades is one such effort.(The WNET Group, 2007)

3.1.1 Pre-colonial landscape and land management

Roughly twenty thousand years ago, during the last peak of glaciation, NYC was sealed in a layer of ice thousands of feet thick (Stanford, 2010). As the ice melted in the following centuries, rivers were rerouted, channels were carved, and a brand-new landscape emerged.

For all beings of the Northeast coast, survival required adaptation to these post-glacial and climate fluctuations. Coast Algonquian communities cultivated a deep intimacy with their environments, moving around the area as the seasons shifted their protein sources (Bragdon, 2005).

The Munsee speaking Lunaape people referred to the river we now call the Hudson as "*Mahicannitukw*," meaning "the great tidal river" (The Public History Project, 2020). The makeup of the Mahicannitukw river—its waters fresh at the northern end but increasingly briny as it approaches the Atlantic—created the ideal habitat for salmon, shad, sturgeon, whales, and particularly the critical keystone species of oysters, along with a long list of dependent species in this food web. Additionally, post-glacial pond formations became home to beavers, turtles, waterfowl, plants with medicinal properties, and other flora and fauna valued by Indigenous people. These environments made the region a hub for human food, travel, and trade long before the first European settlers arrived (Lynch et al., 2012; Sanderson, 2009).

The Indigenous communities of our region shared in common a developed, nuanced language, and an understanding of the relationship between humans and the ecologies that nourished them (Goddard, 2010). They thrived in the region by "tending the wilderness"–employing sustainable harvesting and permaculture farming methods and by maintaining a delicate balance with their surroundings.

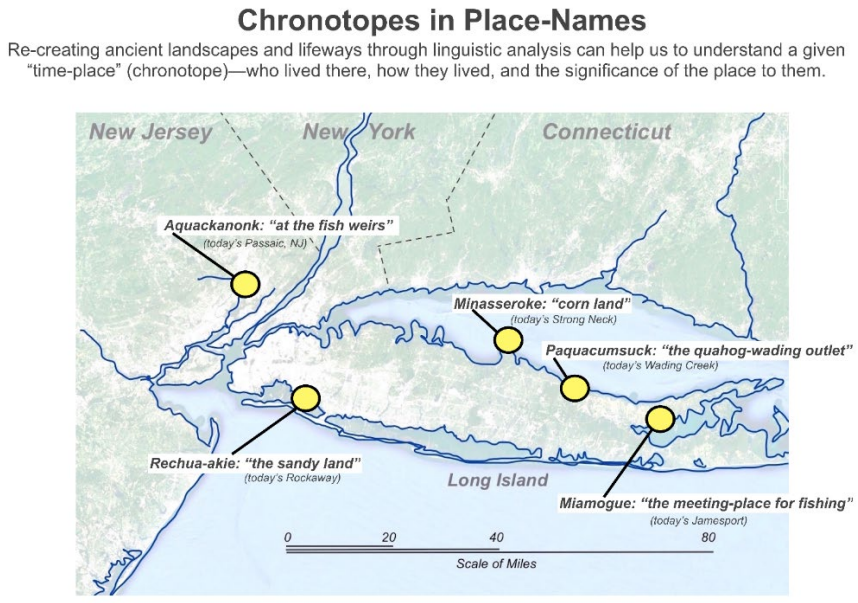

Figure 3: Chronotopes in Place-Names: Source: Public History Project (2023)

[2] "Bioregion" and "ecoregion" are formulations of nature/human relational places by systems ecologists that engage in a dialogue with ILK, TEK, and Western-trained scientists and systems theory. "*A bioregion is a self-reliant geographic unit defined through watersheds, ecoregions, hard physical boundaries and the cultures that stem within them. Bioregion is short for 'bio-cultural region' and are geographically based areas defined by physical traits; land or soil composition, watershed, climate, flora, and fauna; as well as the cultural traits of the inhabitants that live within them, and act upon them. Ultimately, they are defined by the people living within them.*"(Cascadia Department of Bioregion, 2024) (See also Thomashow (Thomashow, 2001))

Their practices included selective harvesting, which meant only taking what was necessary while allowing plants and wildlife to replenish themselves, along with controlled burning of the grasslands, which served many purposes. For instance, burning enriched the soil, which allowed strawberries to crop up in profusion, beckoning the animals they hunted, such as passenger pigeons and turkeys. These practices reflected their intimacy with the land as a living system and the understanding that their own well-being depended on ecosystem health and on practicing care for "all our relations," animal and plant alike (LaDuke, 2016).

3.1.2 European colonization and ransacking the commons

The "discovery" of the Mahicannitukw river by Henry Hudson in 1609 set off an era of drastic change in the uses and abuse of our bioregion (Jennings, 1975; Kalm, 1770).

The arrival of European colonizers brought an extremist extractive mindset that failed to account for the long-term consequences of exploiting the land and its resources, as was noted with concern by visiting Finnish-Swedish botanist Pehr Kalm (Kalm, 1770). The Doctrine of Discovery enabled Christian appropriation of Indigenous lands, resulting in dispossession, ecological disruption, and the destruction of communal resources (Upstander Project, 2023).

The violent imposition of this privatized European economy in the 17th century introduced a capitalist trade and extraction-production structure that replaced Indigenous cultural systems, which centered a shared commons. It marked a shift from a society founded in Indigenous practices of "tending the wild" for sustenance and regeneration to a society where resources were harnessed primarily for their "exchange value" (K. Anderson, 2005; Bollier, 2013). Locale by locale, overexploitation depleted the massive oyster banks, disrupted fish runs, and contaminated groundwaters.

European settlers used extended credit for rum and other European goods to addict and lock Indigenous people in debt, and then used that debt to justify seizing Indigenous assets. In addition, the monetization of wampum gifting disrupted inter-Indigenous social dynamics; some Indigenous groups began demanding tribute in the form of wampum from other groups, even threatening to use violence if they failed to comply. The European trade of wampum also accelerated the depletion of beavers and other animals coveted for their fur.

In the 1630s and 1640s, English and Dutch settlers turned to an even more vicious strategy to occupy and gain land from Indigenous communities and crush resistance. There were at least nine colonial attacks in the region in the span of a decade that can be defined as genocidal massacres—unnecessary, indiscriminate killing of human beings, including children and pregnant women (Anonymous, 2013; Bailyn, 2013, p. 336; Brodhead, 1871, p. 391; de Vries, 2020, p. 173; Jameson, 2000; Melyn, 1850; O'Callaghan, 1848; van der Donck & van Tienhoven, 1856). Murder and subjugation became a regular economic development policy.

Beginning with the British mercenary-led Pequot War at Mystic, which paved the way for British conquest of much of Connecticut and parts of Long Island, followed by Dutch massacres at Corlears Hook (in present day Lower East Side), Pavonia (in present day Jersey City), Pound Ridge (in present day Westchester) and other settlements (Figure 4), the violence set off a series of battles between settlers and Indigenous peoples and would, over time, lead to further Indigenous land dispossession.

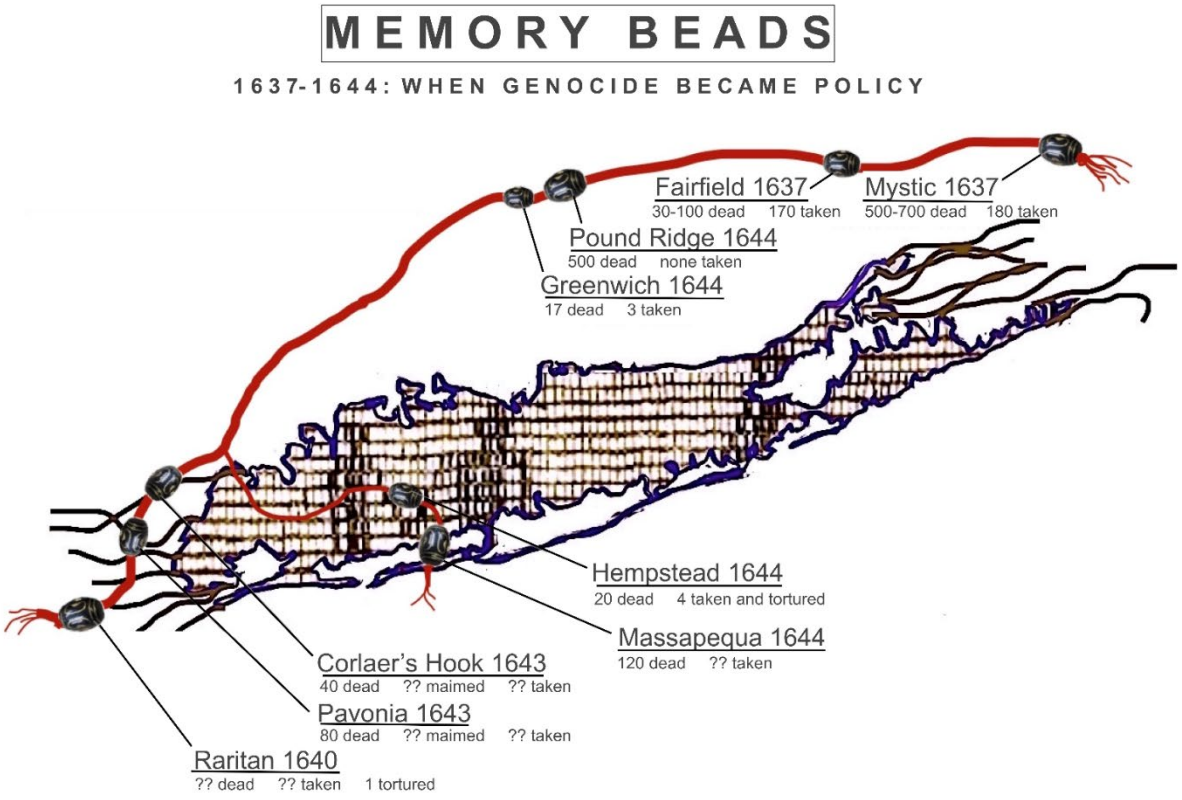

Figure 4: Memory Beads: Source Kerry Hardy and the Public History Project (2023)

Herein the Dutch and the British established a massive global economy based on an interlocking set of relations between money, power, and people spanning four continents (Lowe, 2015; Tchen, 2001). Imperial trade relied heavily on the extraction of resources from the so-called New World using these taken lands and forced labor, which escalated the demand for enslaved Indigenous people and Africans. When the English acquired New York and East and West Jersey from the Dutch in 1664, the shift further intensified the demand for slaves. Enslaved African people were brought to the region and forced to farm the fields formerly planted by Indigenous people and clear away forest to make more fields (Matthews, 2019, p. 9). The labor of enslaved people fueled the city's economy, while the concentration of lands and wealth in the hands of a few exacerbated social inequalities.

By the late eighteenth-century, many living beings in the region were depleted, including beavers, oysters, and whales. Extensive deforestation to clear land for agriculture and to produce fuel and building materials for the developing colonial cities had also destroyed atmosphere stabilizing carbon sinks (Cronon, 2003, p. 178). The ditching of tidal wetlands started as early as the 1600s to alter hydrology and optimize the production of salt hay and other products (Adamowicz et al., 2020; Dahl & Allord, 1996). In 1791, The Society for Establishing Useful Manufactures (SUM) was established by Alexander Hamilton to use the Great Falls at Paterson, NY, a longstanding site for Lunaape, to harness and eventually sell the waterpower to manufacturers (Cowen & Sylla, 2018). Additionally, alterations to waterways through canal construction and marshland reclamation disrupted wetlands, leading to increased flooding, erosion, and the loss of wetland habitats. Over the ensuing decades ,the Passaic River and the adjacent estuarial region became prime manufacturing real estate. Commodifying drained land accelerated the industrialization and pollution west of Manhattan Island – a pattern of land use development already established by King Charles II's massive state drainage policies (Mulry, 2021). These adapted US practices not only resulted in loss of biodiversity and the disruption of ecosystems, but also set the stage for the Industrial Revolution in the US. The fossil fuel emissions from this era now account for the historic accumulation of US emissions, the largest of any nation, still lingering in the atmosphere.

We cannot disregard the ways Dutch, English, and US abuses of the land have made the region and the planet more vulnerable to climate change. Furthermore, that settler-colonial, extremist extractive mindset continues to shape our

society today. Ecological and environmental injustices persist, with Indigenous peoples, people of color, and low-income neighborhoods most affected (The Climate Reality Project, 2021; U.S. EPA Office of Land and Emergency Management, 2020). Marginalized communities are now at risk for the worst impacts of climate change (McDonald et al., 2021, tbl. S4; U.S. Government Accountability Office (GAO), 2021).

Eco-colonialism in the New York metro region is a legacy that will impact everyone in the bioregion and on the planet. It is not only prudent but also the moral duty of policymakers in our region today to recognize this inheritance and to address the inequities and ecological ruin perpetuated by systems that prioritized and fostered wealth accumulation.

3.1.3 Learning from the history and the historical stewards of the land

Climate change in NYC and its bioregion cannot be divorced from the history of colonialism, extractivism, and slavery. Understanding the impacts of these legacies is vital for formulating effective policies and strategies to mitigate and adapt to climate change. Furthermore, knowledge of our history also necessitates a commitment to restorative justice.

Indigenous peoples of North and South America have endured centuries of genocidal violence, leading to the extinction of over 2,000 nations (LaDuke, 2016, p. 1). Despite this immense loss, today there are still at least 3.7 million Indigenous people in the United States, or a total of 9.7 million people when including those who identify as both “American Indian/Alaskan Native” and another racial group (U.S. Census Bureau, 2020). While many of the original people of our bioregion have been dislocated to other parts of the U.S., some remain on the lands they have called home for centuries, including but not limited to the Ramapough Munsee Lunaape and the Sand Hill people of present-day New Jersey (The Public History Project, 2023). Both have recognition from the state of New Jersey but no federal recognition from the Bureau of Indian Affairs. Meanwhile, the Shinnecock, who received federal recognition in 2010, continue to own and occupy aboriginal homelands on the eastern end of Long Island (Shinnecock Nation, n.d.). Indigenous people of diverse nations from throughout the country have also made NYC their home. The city has the largest concentration of Indigenous peoples in the U.S., with the Manhattan-based American Indian Community House serving people from 72 nations (“About The American Indian Community House,” n.d.; First Peoples | The New York State Museum, n.d.).

Far from being “erased,” Indigenous groups in our bioregion and in North America at large continue to struggle for the return of land to Indigenous sovereignty (NDN Collective, 2021). A true commitment to principles of equity and justice require that today’s policymakers take seriously Indigenous movements for the right to steward their original homelands and for greater consent in decisions that impact their access to sustainable food, shelter, and more (Thompson, 2020).

Thinking locally, it may seem challenging to conceptualize how to bring a crowded, acutely privatized city like New York back into the hands of the Lunaape, especially given the dislocation of many Lunaape people and the Indigenous diversity of present-day NYC. Yet Indigenous advocates and allies are already articulating steps worthy of consideration. For instance, in Shinnecock Bay off the coast of Long Island, members of the Shinnecock, working with the Sisters of St. Joseph, have developed a kelp farm that is helping to absorb the excess carbon and nitrates in the water while also providing the Shinnecock with green jobs and a return to stewarding their coastal waters. Collaborating with knowledgeable Indigenous stewards has the dual benefit of respecting Indigenous sovereignty demands while also addressing our city’s environmental issues and caring for our vulnerable coastal areas (Kleczek, 2023; Leonard, 2021). In addition, the city can explore furthering investment in land stewardship models like the community land trust, which privileges a community’s needs—whether for affordable housing or climate resiliency infrastructure—over an individual’s potential to generate wealth (Dudley Street Neighborhood Initiative, 2023; NDN Collective, 2021; Thompson, 2020; United States Census Bureau, 2022). Policy-makers—and the public—must also be open to learning from Indigenous Land education (McCoy et al., 2017; Tuck et al., 2014). Those still on homelands possess profound insights into the bioregions they inhabit. Indigenous practices offer alternative models of relating to the land that ensures the well-being of both humans and our shared natural world and that can help us address the root causes of our disconnection from the environment and seek solutions for an inclusive, biodiverse future (United States Census Bureau, 2022). Collaborating with Indigenous communities and integrating these fundamental, embodied, long-memory insights into political decision-making processes can pave the way for more just and ecologically conscious policy approaches to climate action.

3.2 Historical and Contemporary Land Use Patterns and Climate Risk

Historical land use decisions contribute to climate risk today and to who bears that risk. Working to eliminate inequities in climate risk requires understanding this more recent history, as well as the ongoing practices that perpetuate them. There are clear linkages between past land use and present climate risk; at the same time, the characteristics of this relationship depend on local histories and context. Nevertheless, common themes emerge and can help explain patterns in New York today. To explore these relationships across a range of land use issues—

including zoning, development decisions, geography, and transportation—this section will use the following framework (See Figure 5). Past land use practices affect climate risk directly and indirectly through how they affect current land use patterns and social vulnerability. In turn, these climate risks also shape land use patterns.

- **Past land use practices affect climate risk directly.** For example, formerly industrial areas may still have contaminated soil or other health risks. Often, the areas develop into low-income residential neighborhoods because the land is relatively inexpensive. The residents are then more exposed to toxic contaminants during extreme weather events, such as storm surges.
- **Past land use practices affect current land use patterns, which affect climate risk.** Redlined neighborhoods typically have developed over time to have higher rates of impervious surfaces and less investment in green space, resulting in intensified heat waves.
- **A combination of current land use patterns and climate risk affects future land use patterns.** Low-income, high-elevation neighborhoods may see rising property values that lead to displacement and other changes in residential patterns.

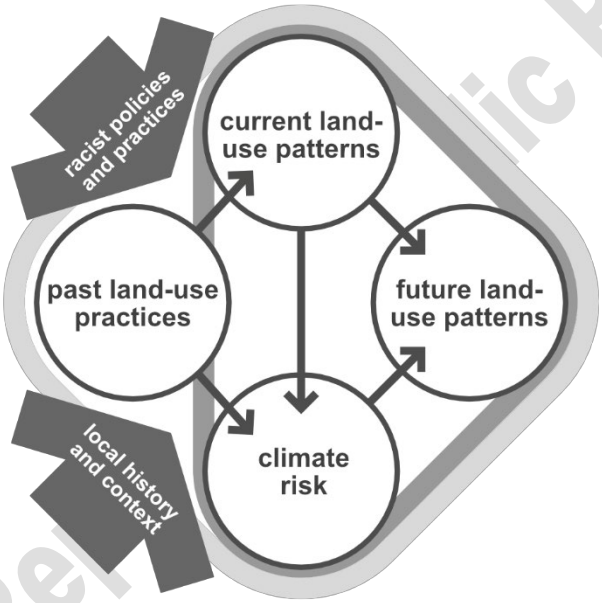

Figure 5: Framework for the relationship between Historic and Present Land Uses, Climate Risk, and Social Vulnerability |

Although many studies use a social vulnerability lens to understand each of these categories individually, such as showing that people of color face greater heat wave-related mortality in New York (Madrigano et al., 2015), fewer studies empirically lay out these series of relationships: past land use practices produce social vulnerability, leading to specific climate vulnerabilities, leading to future land use patterns with their own inequities. Notably, the Madrigano study used multiple factors spanning demographics and the physical environment to assess heat wave-related mortality risk. This led to a composite Heat Vulnerability Index that NYC has continued to use and refine (City of New York Department of Health and Mental Hygiene, 2022a).

The following sections will map out the state of the research across each of these relationships.

3.2.1 Zoning, land use planning, and climate risks

Zoning and land use planning have been powerful tools for creating and enforcing racial and class segregation in U.S. urban areas, including suburban neighborhoods within and surrounding city boundaries (Whittemore, 2021). In addition to these socio-demographic consequences, zoning also determines many physical characteristics of communities, such as where hazards are located, who has access to green space, tree canopy cover, and development patterns.

3.2.1.1 Redlining

Old government maps by the federal Home Owners' Loan Corporation (HOLC) outlined neighborhoods in more than 200 U.S. cities and rated them for inclusion in government home mortgage and lending programs (Aaronson, Faber, et al., 2021; Aaronson, Hartley, et al., 2021). These color-coded maps rated (and marked) neighborhoods from least risky to most risky — "A" through "D"; the "D" areas (red) were neighborhoods where Black residents lived. This practice is referred to as "redlining." The result was that Black homeowners could not qualify for home loans that were backed by government insurance programs, essentially zoning out Black neighborhoods from investment (Aaronson, Faber, et al., 2021; Aaronson, Hartley, et al., 2021). As such, while "redlining" was not technically a land use policy, the practice operated like a zoning map, designating areas where Blacks and whites could and should live based on their ability to secure a mortgage and other financing.

One consequence of governments and private entities' disinvesting in redlined neighborhoods over time is that these areas, even today, lack heat- and flood-mitigating infrastructure relative to neighborhoods with higher HOLC grades (Hoffman et al., 2020; Wilson, 2020). At the same time, redlining and other discriminatory housing policies (such as racial covenants) precluded people of color from moving to areas with fewer environmental risks and more resilient features. Although there is mixed evidence on to what extent formerly redlined areas have retained their original demographic composition (R. Best & Mejia, 2022; Perry & Harshbarger, 2019), many low-income residents and residents of color continue to live in formerly redlined areas today.

In NYC, spatial inequities have changed over time due to population migration, upzoning, urban renewal, and displacement–all making the influence of redlining and other historical land use issues more complex and less direct (City of New York Office of the Mayor, 2020). Although HOLC deemed 54 percent of Manhattan's land area as "hazardous" in the 1930s, some of these areas are now affluent neighborhoods; this relationship is further complicated by the neighborhoods' high but uneven prevalence of air conditioning, making redlining even less of a predictor for heat vulnerability today (City of New York Department of Health and Mental Hygiene, 2021b; *Not Even Past*, n.d.).

Nevertheless, formerly redlined neighborhoods appear to be more likely than non-redlined neighborhoods to be facing high flood risk, disproportionately impacting households of color (Katz, 2021). These discrepancies are much larger in a handful of U.S. metros, including Sacramento, New York, Boston and Chicago (Katz, 2021). In NYC, census tracts that had been graded "A" or "B" have significantly lower flood risk under four scenarios—extreme and deep contiguous flooding, extreme nuisance flooding, moderate deep and contiguous flooding, and moderate nuisance flooding—than those with "C" and "D" grades (Steinberg-McElroy et al., Forthcoming).

Moreover, these disparate risks are increasingly being quantified. One analysis of Los Angeles, California, found that between 197,000 and 874,000 people—and between $36 and $108 billion in property—within the 100-year floodplain are exposed to flooding greater than 30 centimeters (about 11.81 in), disproportionately so in non-Hispanic Black communities (Sanders et al., 2022). An earlier study of NYC found that the non-Hispanic Black population in 100-year floodplain (relative to what is expected based on population size) was nearly 60 percent higher in Manhattan, 40 percent higher in the Bronx, and nearly 100 percent higher in Queens, whereas the Non-Hispanic White population was approximately 100 percent higher in the Bronx and 40 percent higher in Brooklyn. The authors of the study attribute these differences to past and changing land use patterns (Maantay & Maroko, 2009; *Not Even Past*, n.d.). The history of redlining also contributes to inequities in disaster protection and recovery funding. For example, redlining has led to lower property values, which can result in fewer government flood-protection funds (Katz, 2021). It's worth noting that these lower-valued properties often retain disproportionately higher property tax assessments relative to their actual market values, thus increasing the financial burden on low-income people (Center for Municipal Finance, n.d.; Editorial Board, 2021). Some federal flood mitigation grants for homeowners require matching, often making them unaffordable particularly for residents who have not been able to build wealth through homeownership (Dorazio, 2022). Inequities in disaster relief also stem from many aspects of redlining: homes are likely less resilient to natural disasters and face more damage; lower property values result in fewer funds to cover damage; and a lack of previous repairs means that properties may not be eligible for certain programs (Dorazio, 2022; Sturgis, 2018).

Climate risk today—particularly with respect to climate gentrification—may influence how these spatial inequities continue to evolve. One study suggests that outmigration can concentrate low-income households in flood zones. When the housing market experiences a drop in demand and prices, high-income people who can accept lower offers leave the neighborhood, while only low-income people are able to stay—or even move into the neighborhood (de Koning & Filatova, 2020).

3.2.1.2 Exclusionary zoning

Historically, zoning regulations that favored single-family homes and larger lot sizes were designed to make neighborhoods less accessible and more exclusive (Trounstine, 2018). For this reason, single-family zoning is often referred to as "exclusionary zoning" because it emerged as a way to keep racial and ethnic minority groups out of the

suburbs after explicit racial zoning was found to be unconstitutional (Trounstine, 2018). The exclusionary nature of many suburbs meant that low-income residents of color, including those who live in NYC, were locked out of these neighborhoods and consigned to segregated neighborhoods in the city (City of New York Office of the Mayor, 2020).

From a climate justice perspective, many of the places contributing to greenhouse gas emissions the most (per person), including the suburbs of New York, are more protected from climate impacts, while also receiving the most renewable energy and electric vehicle subsidies. According to one report, households in New York metropolitan area suburbs and exurbs have emissions footprints that are two to three times as large as those in parts of Brooklyn or Manhattan (Plumer, 2022). Residents of compact neighborhoods in the city, and particularly low-income residents, have a lower carbon footprint because of the density and everything it enables, such as public transit and walkability (Popovich et al., 2022).

Many suburbs have also remained greener and, therefore, cooler, and environmentally healthier due to policies that perpetuate exclusion today, such as single-family zoning, and a lack of enforcement of fair housing laws. When higher-risk geographies have lower housing costs, rapidly growing urban areas may develop these areas to accommodate a growing population. For example, one study of Austin, Texas, found that low property prices caused the proportion of low-income residents living in floodplains to increase between 1990 and 2000 (Lee & Jung, 2014). Since this is an emerging body of literature, more research is needed to understand how repeated climate shocks affect displacement and whether residents are more likely to move to areas of sprawl.

3.2.1.3 Hazardous and industrial land uses

Historically, zoning policies for industrial and hazardous land uses have either targeted less expensive land or reduced land value. Hazardous and industrial land uses are intertwined with segregation and expulsive zoning practices, resulting in greater exposure to certain pollutants in communities of color. Expulsive zoning targets low-income communities and communities of color with noxious uses, which not only expand industrial zones but also accelerate gentrification in nearby neighborhoods that do not have these uses. In 2022, the U.S. Department of Housing and Urban Development found that the city of Chicago has been instrumental in efforts to move industrial facilities from predominantly white to predominantly non-white neighborhoods—one example of how governments continue to use zoning and land use policies to intentionally facilitate environmental injustice (Nexus Media News, 2022).

Historically, under expulsive zoning, low-income people and people of color were disproportionately displaced to the more industrial neighborhoods or became unable to afford to move out of these neighborhoods (Maantay, 2002). Today, predominantly low-income neighborhoods remain more likely to be targeted for, or to host, environmental hazards (Mizutani, 2018). One recent study, for example, finds that racially segregated residential areas are more strongly associated with fine particulate metals from human activity (such as industrial emissions, vehicle engines and shipping emissions) than natural sources (City of New York Department of Health and Mental Hygiene, 2022b; Kodros et al., 2022). Higher-income, predominantly white populations may move away from newly introduced hazards, leaving lower-income residents with the greatest exposure. Additionally, these racially segregated residential areas also often have higher incidences of air pollution and urban heat island. See NPCC4, Matte et al (Matte et al., 2024).

Legacy pollutants common in current or formerly industrial zones persist in the soil and can be released during flooding and storms (Marlow et al., 2022), reflecting how past land use decisions directly affect residents' climate and environmental health risks today. Storms may increase contaminant transport near Superfund sites (2019), and two million people in the U.S. live within a mile of Superfund sites in areas prone to flooding or vulnerable to sea-level rise (Dearen et al., 2017). A review of sites within six metro areas found that socially vulnerable groups (taking into account demographics, socioeconomic status, and housing status) were disproportionately likely to live in areas with elevated flooding risks near former industrial sites. (Marlow et al., 2022). Moreover, more than 9,000 current federally subsidized housing properties currently sit within a mile of a Superfund site (Caputo & Lerner, 2021).

Indirectly, these past land use decisions can affect land use patterns today, which then have implications for climate risk. In New York, the creation of official Significant Maritime and Industrial Areas (SMIAs) in 1992 has resulted in the further siting and clustering of environmental hazards in predominantly low-income communities of color. These areas were created to encourage the protection and siting of industrial and maritime uses along the waterfront. Historically, industrial land was often on the waterfront due to the city's shipping history and low-income residents were often placed in public housing in industrial areas or moved there because of the availability of low-cost housing. One study finds that all six[3] SMIAs are in hurricane storm surge zones, leading to greater risks for residents in these

[3] There are now seven SMIAs.

neighborhoods (Bautista, Hanhardt, et al., 2015) [4]. According to this study, the creation of SMIAs also resulted in the further siting and clustering of environmental hazards in predominantly low-income communities of color.

At the same time, as neighborhoods shift away from hazardous and industrial uses, zoning decisions today can influence who bears greater risks of both climate impacts and climate gentrification in the future. When areas have transitional land uses and flexible zoning, combined with low exposure to climate impacts, they may be more likely to experience new development (Tedesco et al., 2022). These land use decisions not only affect neighborhoods differently but also the populations within each neighborhood. In the case of brownfield redevelopment in Manhattan, neighborhoods with certain amenities (such as waterfront property and public transit) experienced increased gentrification. The rising costs of living had the greatest impact on the elderly, renters, and those using government assistance (Pearsall, 2010).

3.2.2 Development and investment decisions

Development decisions have long-term repercussions. Similarly, investments in resilience, and disparities in those investments, have been a direct result of historical and modern-day land use decisions. Today, these types of investments play a role in climate gentrification. Large-scale investments in climate adaptation and resilience—ranging from green infrastructure to seawalls to buyouts—affect the development landscape and the climate riskscape.

3.2.2.1 Housing development

Large building complexes (including many federally subsidized buildings) were typically placed in areas with inexpensive land, which continue to be more affordable neighborhoods today. These buildings and their related infrastructure were constructed with heat-absorbing materials that intensify the urban heat island effect, continuing to disproportionately impact the predominantly low-income residents (Hoffman et al., 2020). In addition to the environmental effects of the construction materials, low-income renters of color are more likely to live in housing that is older, substandard, and less maintained; these quality issues increase the risk of structural collapse and damage to people and properties during extreme weather events (Burby et al., 2003; Cash et al., 2020; Fussell, 2015; Krause & Reeves, 2017; Rosenbaum, 1996). Moreover, housing continues to be built in riskier areas and with less resilient materials, including new construction of affordable housing (Hammett et al., 2018; Mervosh, 2019; Uhlmann, 2018).

In NYC, these effects are not as straightforward. Although densely developed neighborhoods with masonry and steel apartment buildings do have higher overnight minimum outdoor temperatures (Eliezer et al., 2019), the same structures can reduce heat exposure in several ways: by gaining heat more slowly (Urban Green Council, 2014); by being more energy efficient and having lower energy costs than single-family homes (U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, n.d.); by having less exposure to outdoor heat or cold due to adjacent unit walls (U.S. Energy Information Administration, 2013); and, by helping to shade streets and sidewalks, thereby reducing daytime surface temperatures relative to outer boroughs (City of New York, n.d., 2021).

Multifamily buildings constructed with masonry and steel are more able to survive flooding than single-family homes with wood frames, as illustrated by the storm surge during Hurricane Sandy (Sandy Regional Assembly, 2013). However, residents of larger buildings were still affected by damage to electrical, heating, elevator, and water supply systems and would benefit from flood hardening and other resilience strategies (Lane et al., 2013).

The development of public and affordable housing also has a distinct relationship with climate vulnerability. Inexpensive land tends to be located in areas of environmental risk, which contributes to the government's decision to place public housing in these geographies. One early study of floodplain areas in Austin found that such areas have been developed for multi-family housing, mobile homes, and single-family housing in low-income neighborhoods between 1990 and 2000 (Lee & Jung, 2014). More recent studies continue to document the relationship between flooding risks and affordable housing. In fact, approximately 9 percent of all subsidized or public housing projects in the US are in 100-year or 500-year floodplains (Mervosh, 2019; Peri et al., n.d.; Rosoff & Yager, 2017) and the number of affordable units exposed to flooding and sea level rise in the United States is projected to more than triple by 2050 (Buchanan et al., 2020). Coastal states are estimated to have at least some affordable housing units exposed to flood risk events at least four times year, with the most vulnerable cities highly concentrated along the northeastern corridor and in California (Buchanan et al., 2020). In some of these cities, over 90 percent of their

[4] This pattern does not always hold. For example, contaminants can also exist in neighborhoods that have undergone significant land use and demographic change. In New Orleans, formerly industrial sites have been converted to other uses, most commonly in predominantly White neighborhoods. (Frickel & Elliott, 2008)

relatively smaller affordable housing stocks are expected to be exposed to flooding. However, the study finds, NYC remains the most vulnerable in absolute terms (Buchanan et al., 2020).

In New York, 17 percent of the New York City Housing Authority's buildings are in the 100-year floodplain or Special Flood Hazard Area (SFHA), and this is expected to rise to 26 percent over the next few decades due to sea level rise (Yeung & Levers, 2022). NYCHA's Climate Adaptation Plan recognizes the need to prioritize the protection of critical infrastructure in these developments (New York City Housing Authority, 2023). Additionally, not all areas that flood are within FEMA-designated floodplains (See NPCC4, Rosenzweig et al., (Rosenzweig et al., 2024)).

In addition to the impact of housing development decisions on climate risk, disasters have a range of inequitable consequences for housing. Redeveloping public housing into mixed-income units after a disaster exacerbates the existing shortage of public housing units, as happened in New Orleans after Hurricane Katrina; this also shapes whether residents can (or want to) return as their neighborhood changes (Fessler, 2015). These changes can also emerge over time. After Hurricane Katrina, the neighborhoods that were slower to recover—which typically also had greater social vulnerability—became the fastest growing neighborhoods in the early 2010s, with gentrification being one factor in the newly accelerated growth (Peacock et al., 2014). Plus, the housing shortages after disasters—even without redevelopment—and the resulting rise in prices can play a role in neighborhood change (Fussell et al., 2010; Peacock et al., 2014).

3.2.2.2 Buyouts

Similarly, buyout programs initiated in response to repeated disasters have a variety of disparate impacts on low-income residents and residents of color (Kraan et al., 2021).

Although nationally wealthier counties have implemented more buyouts, the affected properties within those counties tend to have lower incomes and greater racial diversity (Mach et al., 2019). One study finds that whiter counties and neighborhoods have more access to federal buyout assistance, but homeowners in neighborhoods of color are more likely to accept that assistance (Elliott et al., 2020). This helps to explain why non-white neighborhoods in predominantly white counties see the greatest demolition (Elliott et al., 2020). In another study, the majority of FEMA-funded buyouts were found to be located outside of zones that HOLC had assessed. For the areas HOLC had graded in historic urban cores, most buyouts were located in redlined districts (Zavar & Fischer, 2021). In addition to inequities in the buyout process itself, other issues include unequal access to information about the process, dislocation from social networks, and relocation costs.

Buyouts may also facilitate racial segregation. One recent study that traced the path of over ten thousand federally funded buyouts across the country finds that retreating homeowners in majority-white neighborhoods are willing to endure 30% higher flood risk before selling to the government and relocating than homeowners in majority Black neighborhoods. The study also finds that white families in neighborhoods that utilize FEMA buyout money move to wealthier and whiter areas, while residents of majority-minority neighborhoods were more likely to move to neighborhoods that are majority-Black or majority-Hispanic (Elliott & Wang, 2023).

At the same time, wealthier, whiter communities are more likely to receive support for seawalls, funding to elevate homes, or drainage infrastructure (Nance et al., 2022; Siders & Keenan, 2020). Without this protective infrastructure, residents in low-income communities may want buyouts. However, when properties are undervalued during the appraisal process, people who want to move may not be considered eligible for some buyout programs despite the climate risks they face. Equity issues with benefit-cost analysis methods can compound concerns about buyouts (See NPCC4, Balk et al, (Balk, McPhearson, et al., 2024)). To qualify for federal FEMA funds, the cost of flooding must exceed the cost of acquisition and demolition, which can disproportionately exclude residents of neighborhoods with low land values (Patterson, 2018). FEMA has introduced an alternative method for determining cost-effectiveness, but the impact remains to be evaluated (Association of State Floodplain Managers, 2022; Siders, 2019). Without transparency around buyout decision-making processes, residents do not know how home values are being appraised or how the buyouts are being allocated, leading to the feeling that relocation is the only financially viable option being offered (Shi et al., 2022). Although buyouts are intended to reduce vulnerability to climate impacts, this outcome is not guaranteed without significant changes to those programs (Kraan et al., 2021).

Moreover, in hot housing markets, many people cannot afford a comparable home and may not be able to move to a less risky neighborhood (Shi et al., 2022). One study of a buyout program in New York after Hurricane Sandy, the New York Rising Buyout and Acquisition Program, found that 20 percent of households studied relocated to an area with exposure to coastal flood hazards. And 99 percent relocated to an area with higher social vulnerability (McGhee et al., 2020).

To better understand and address these types of issues, a series of workshops in 2022 discussed shared challenges, lessons learned, and recommendations for improving buyouts, including how they can be fairer (*Innovations in Buyouts Workshops*, n.d.). Additional work will continue to be needed to prevent and remedy the inequities to which buyouts can and have contributed.

3.2.2.3 Resilience-promoting investments

Disparities in parks (Rigolon et al., 2018), tree cover, and other green infrastructure investments contribute to inequities in climate risk and resilience. For example, one study finds that the public right-of-way has less tree cover in neighborhoods with higher proportions of residents who are Black, low-income, or renters (Landry & Chakraborty, 2009). This is related to redlining nationally: in one study of 37 U.S. cities, formerly redlined areas (i.e., D graded) have about 23 percent tree canopy coverage, whereas areas with the highest grading (i.e., A and B) have about 43 percent coverage today (Locke et al., 2021). Because higher HOLC grades are associated with significantly higher percentages of tree canopy coverage today, these neighborhoods not only can better mitigate urban heat and flooding but also gain health, aesthetic, and other benefits (Namin et al., 2020).

These patterns, however, are not identical across cities. In Baltimore, Black residents have more access to parks within walking distance, but white residents have more acreage of parks within walking distance, which are less congested (Boone et al., 2009). Baltimore's historical *de jure* segregation created predominantly black neighborhoods without park access until a period of white flight and suburbanization changed settlement patterns throughout Baltimore, resulting in Black residents living closer to the parks from which they had previously been excluded. Contextualizing current land use patterns is critical for understanding the impact of amenities over time.

Access to parks within walking distance in NYC is relatively robust, with nearly 99% of New Yorkers residing within a 10-minute walk of a park, according to a recent study by the Trust for Public Land (Rozon, 2023). However, the ability to reach larger parks is more limited without a car, and fewer of these areas are transit-accessible or near public and affordable housing. As such, according to the study, in New York, residents living in neighborhoods of color have access to 32% less nearby park space than those living in white neighborhoods and residents living in lower-income neighborhoods have access to 19% less nearby park space than those in higher-income neighborhoods. Moreover, a report from Natural Areas Conservancy found that natural areas are significantly cooler than the rest of the city, and so disparities in park access have consequences for heat exposure and health (Crown et al., 2023).

Today, resilience-promoting investments can continue to create inequities through several channels, including maladaptation and climate gentrification. In one example of how maladaptation can increase physical risks, the protection of individual shoreline segments can increase flooding and damages in other areas, and in some cases regional flood damages (Hummel et al., 2021). Structural mitigation—as defined by physical construction or engineering to reduce or avoid impacts on structures, such as raising buildings—also raises the cost of coastal redevelopment, making coastal areas more expensive and more exclusive (Gould & Lewis, 2018). The demand for waterfront property in NYC continues to outweigh flooding concerns, leading to high demand real estate markets that are seen as better candidates for structural mitigation. The higher building costs are then passed on to those who can afford to live in and develop these neighborhoods (i.e., the resilience pathway of climate gentrification) (Gould & Lewis, 2018). However, in one example of equity-focused resilience-promoting investments, NYC's Climate Strong Communities program aims to invest in infrastructure within vulnerable communities that have received fewer resiliency investments historically or post-Sandy (For more information on this program, see section 2.1).

Resilience-promoting investments in multifamily affordable housing developments have the potential to address some of these inequities. For example, energy back-up systems–particularly those coupled with rooftop solar–can help residents vulnerable to climate impacts and their social-economic consequences maintain power during heat waves and coastal storms. Although residential clean energy subsidies have largely gone to more affluent households (Borenstein & Davis, 2016), there are currently efforts to bring the benefits of renewable energy–from phone charging to medical equipment to cooling and heating common rooms–to environmental justice communities within the city.

Most of the benefits of green infrastructure go to areas with wealthier, whiter and better educated residents (Shokry et al., 2020), and parks are typically associated with gentrification processes (with the exception of historically Black post-industrial cities experiencing disinvestment and high rates of vacant land) (Triguero-Mas et al., 2022). Without anti-displacement strategies in place, resilience-promoting investments can have inequitable outcomes.

3.2.3 Geography and displacement

Different geographies have advantages and disadvantages that affect land costs, amenities, and residential settlement patterns.

3.2.3.1 Elevation

Both historically and today, elevation has been a factor in land use decisions. However, the relationships among elevation, development, and social vulnerability depend on each locality's social and environmental context. For example, inland cities tend to have residential patterns in which income correlates with elevation, but coastal cities see the reverse pattern (Ueland & Warf, 2006). Low-lying waterfronts may serve as an amenity that drives up land costs or as a disamenity because of its potential for industrial uses. For individual cities, context is key to understanding elevation as a factor in climate risk and who bears that risk today.

In NYC, low-lying marshes were historically considered an environmental disamenity. Even after sanitation infrastructure was introduced, historical marsh sites have continued to be disproportionately low-income, with housing prices rising with distance from these sites (Villareal, 2013). One study suggests that relative elevation may better correlate with socioeconomic status in New York; it also recognizes that some high-elevation areas, such as in Staten Island, may also have unwanted land uses and predominantly low-income populations, potentially because these areas used to be more difficult to access (Brisbane, 2014). Even within NYC, these mixed patterns demonstrate how elevation can be a complex factor in land use decisions that does not have a straightforward relationship with social vulnerability.

In some cities, climate impacts are making high elevation more desirable, leading to climate gentrification and displacement. Empirically, flood depth and lower ground elevation have been shown to be inversely associated with gentrification, causing higher-elevation neighborhoods to become significantly whiter and higher income (Aune et al., 2020). In the example of Miami-Dade County, the rate of single-family home price appreciation is positively correlated with higher elevation, and price appreciation in the lowest-elevation cohorts have not kept up since 2000 (Keenan et al., 2018). The high-elevation neighborhood Little Haiti has historically had little investment but is now experiencing a development boom, partly because of its low land costs. The neighborhood is predominantly low-income and Black, and its rising housing prices are now displacing long-term residents (Campo-Flores & Kusisto, 2019; WLRN, 2019). The literature on climate gentrification and displacement is explored further in Section 4.1 below.

Although elevation can contribute to land use and demographic patterns, there is a range of different evidence across contexts (and even within cities), with no straightforward or single explanation. When considering the effects of elevation in NYC, these relationships are equally nuanced.

3.2.3.2 Waterfronts and coasts

In some cities, coasts serve as amenities that attract investment and have higher property values. Although wealthier residents in some cities may currently be more likely to live in these flood-prone areas, they also have more resources to cope with disruption and disasters (Collins et al., 2018). In New York, building codes for new housing were strengthened after Hurricane Sandy, making new development more resilient (even on the waterfront), but not necessarily more affordable. Like elevation, waterfronts and coasts have highly context-dependent effects on land use and climate risk.[5]

However, the link between waterfronts and high-income residents has not always been a consistent pattern over time. In NYC, both the land uses and population associated with waterfronts have changed. For most of its history, the city's low-lying waterfront was largely used for industrial purposes; it wasn't until the 1960s that New York's waterfront began to be reimagined as a recreational and/or residential space (Platt, 2009). Many of these areas were not rated by HOLC because, at the time, they were not residential. As they became desirable places for residential development (including some built on landfill, such as Battery Park City), plans for affordable housing have not kept up with market pressure (Jacobson, 2018). Today, New York's waterfront has become a special point of interest among environmental justice advocates, due to new high-end real estate developments on the waterfront which can displace local residents (Turan, 2018).

3.2.4 Transportation

Transportation planning has implications for both land use patterns and climate risk. Access to transportation options and transportation infrastructure itself affects people's capacity to evacuate, how much disruption they experience during and after disasters, and certain physical characteristics of their communities.

[5] One study takes this contextual approach to analyzing the process of racial coastal formation on Sapelo Island, Georgia. The authors identify land ownership, employment, and barriers to inclusion in adaptation planning as factors in vulnerability to seal-level rise on this waterfront.(Hardy et al., 2017)

3.2.4.1 Disruption and evacuation

Transit disruption particularly affects communities with already-low access to transit, even if they are farther from the worst climate impacts (Faber, 2015). In addition to unequal access to public transit, renter, single-parent, low-income, and non-white households tend to have less access to personal vehicles—one factor in the slower and lower evacuation rates observed. (Living near congested city centers also plays a role in these rates) (Cutter & Emrich, 2006; Van Zandt et al., 2012).

These inequities are clear in New York: among all households in the lower quintile of income in the state, vehicle costs are 18 percent of income, on average; more affluent households have more vehicles, which comprise a smaller share of their income, and also have greater flexibility in hours and remote work (U.S. Bureau of Labor Statistics, 2021).

Additionally, federal infrastructure policy continues to favor highways over infrastructure for transit. Even when transit infrastructure exists, it often faces its own climate vulnerabilities. The ongoing PROTECT program intends to address these vulnerabilities (*Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Program (PROTECT) | US Department of Transportation*, n.d.). In NYC, 79 percent of transportation and utility land uses that support essential infrastructure—electric and gas utilities, rail yards, airports, docks and piers, bridges, tunnels, and highways—are in the 100-year floodplain (Yeung & Levers, 2022). These infrastructure vulnerabilities compound disruption and evacuation concerns.

3.2.4.2 Urban renewal

Focusing on the transportation-related aspects of urban renewal, federally incentivized roadways were often built through low-income neighborhoods—including many redlined neighborhoods that were divided by highways—thereby increasing the amount of heat-absorbing land cover (Hoffman et al., 2020). Like the construction of housing or large complexes, these materials intensify the urban heat island effect in the immediate communities where they are located. The interplay between roadways, development, and redlining has a cumulative effect on how extreme heat becomes concentrated in low-income communities and communities of color. Another aspect of these linkages is that exclusionary zoning near suburban railway hubs has limited the stock of affordable, transit-accessible housing in metropolitan areas–again compounding the effects of housing discrimination, transportation inequities, and mobility to and from “greenlined” areas (Regional Plan Association (RPA), 2017).

3.3 Conclusion

The research on historical land use patterns and present-day climate risk is growing (Table 4: Evidence-Supported Mechanisms Between Land Use, Climate Risk, and Social Vulnerability), but more research is needed on how these patterns and relationship influence social vulnerability in particular local contexts. As flood maps are updated and risk projections change, revisiting studies with new data will be useful. Although the relationships between historical land use and climate risk are complex and context-dependent, they often have similar underlying mechanisms, such as lower land costs in risky areas, eroded political capital in marginalized communities, race-based practices that are distinct from but often related to socioeconomic factors, and so on. Many of these land use issues—past and present—are related to and reinforce one another. Without intentional, anti-racist work toward climate mitigation, adaptation, and resilience, NYC will risk perpetuating these inequities in new forms. This requires several key approaches:

1. Incorporating contextual equity and understanding the history of places down to the neighborhood level,
2. taking a holistic approach to reducing racialized vulnerability to climate shocks, including inseparable issues like housing and transit access, and
3. recognizing that the cost burdens of climate adaptation (e.g., higher energy costs, insurance premiums, relocation) affect people differently—particularly when considered alongside homeownership and wealth gaps—and can easily result in increased displacement risks.

Table 4: Evidence-Supported Mechanisms Between Land Use, Climate Risk, and Social Vulnerability

Note: Examples of studies supporting these mechanisms are referenced. * = Studies specific to or inclusive of NYC.

Past and Present Land-Use Practices	Impact on Current and Future Land Use	Impact on Climate Risk and Social Vulnerability
Redlining and Exclusionary Zoning	■ Disinvestment in green and resilient infrastructure (Hoffman et al., 2020*; Wilson, 2020) ■ Restricted mobility to areas with green infrastructure (Rozon, 2023*)	■ Hotter land surface temperatures (City of New York Department of Health and Mental Hygiene, 2021b*) ■ Less tree canopy (Locke et al., 2021*) ■ Inequities in disaster protection and recovery funding (Katz, 2021)
Hazardous and Industrial Land Uses	■ Placement and concentration of hazardous land uses (Kodros et al., 2022) ■ Restricted mobility and greater racial segregation (Mizutani, 2018)	■ Compounded and cumulative environmental health risks (Marlow et al., 2022) ■ Legacy pollutants released during foods and storms (Ibid.)
Housing and Other Development Decisions	■ Inexpensive land tends to be located in areas of environmental risk (Hoffman et al., 2020) ■ Placement of public and subsidized housing in risky areas (Uhlmann, 2018) ■ Affordable housing built with less resilient materials (Cash et al., 2020)	■ High exposure of public subsidized housing units to flooding and sea level rise (Rosoff & Yager, 2017*) ■ Gentrification and displacement post-disaster (Peacock et al., 2014) ■ Change in the composition of homebuyers in less expensive, flood-prone areas (de Koning & Filatova, 2020)
Managed Retreat: Buyouts	■ High percentage of buyouts in formerly redlined neighborhoods (Zavar & Fischer, 2021) ■ Greater demolition in non-white and underinvested neighborhoods (Elliott et al., 2020)	■ Inequities in buyouts shape who stays and leaves (Elliott & Wang, 2023) ■ Relocation to areas with higher climate exposure and social vulnerability (Shi et al., 2022)
Resilience-Promoting Investments	■ Inequities in parks, tree canopy in low-income, black areas (Boone et al., 2009) ■ Shoreline armoring affects demand for waterfront properties (Gould & Lewis, 2021)	■ Maladaptation: protection of shoreline can increase flooding in other areas (Hummel et al., 2021) ■ Climate displacement and gentrification (Gould & Lewis, 2018)

4 Identifying Risks at the Intersection of Historical Patterns of Injustice and Climate Change

Based on the above analysis of the ways that historical and contemporary land uses and a host of other factors shape the risks of populations in NYC, the NPCC investigated potential metrics that could be used to assess the ongoing vulnerability of local populations to climate change. In its last report, NPCC3 examined and assessed methodological approaches used for social vulnerability analysis and mapping in NYC and elsewhere. In this iteration, NPCC4 proposes to capture another dimension of social vulnerability to climate change: climate displacement. It is evident that displacement is projected to be one of the most devastating and widespread impacts of climate change (Cash et al., 2020; Melix et al., 2023). However, it is not always clear what the relationship is between social drivers of displacement—whether as the result of eviction, unaffordable housing costs, or poor-quality housing (Citizens Housing Planning Council (CHPC) of New York City, 2002; City of New York, 2023b) and climate risks and hazards. Fortunately, an emerging body of research has added to our understanding of the ways that climate impacts and adaptations may contribute to changes in community characteristics and potential displacement of vulnerable residents through interactions with social and economic drivers of displacement (K. Best & Jouzi, 2022).

Understanding and quantifying the compounding effects of climate change, displacement, and socio-vulnerability is crucial for the ability of local governments to adopt mitigation and adaptation policies that do not entrench and further the kind of unjust land patterns and development that the previous sections detailed. In this section, we summarize the state of the science and research on climate gentrification, to situate the vulnerability of specific populations to displacement which results from a complex interaction of factors and forces. We then suggest that the City adopt a recently proposed Climate Displacement Social Vulnerability (CDSV) score that integrates socio-economic, climate risk, evictions, and housing data to better measure the risks of climate displacement at the census-tract level in NYC (Tedesco et al., 2024). If the City is able to measure the risks of climate displacement at an appropriate scale, such as at the neighborhood level, then it could determine whether and how new climate-resilient infrastructure or infrastructure investments might risk displacement and identify ways to mitigate that risk.

4.1 Defining and Understanding Climate Displacement and Gentrification

Displacement is most often defined as the involuntary movement of an individual or family from their home or neighborhood. This definition has traditionally not included the ways that climate impacts and adaptations can contribute to displacement of vulnerable populations (Farbotko, 2019; J. K. Maldonado et al., 2014; Shokry et al., 2020, 2022; Tedesco et al., 2022; Triguero-Mas et al., 2022), including bluelining (Fleming et al., 2022), and decreasing health conditions associated with climate hazards, such as flooding or heatwaves (Rocque et al., 2021). Several definitions have been used for climate displacement. However, as a general matter, climate displacement is understood as forced migration occurring entirely or partially from environmental events or from long-term changes related to climate change. (Tedesco et al, 2024). Connecting displacement and climate or environmental hazards is a complex task due to a multitude of environmental and climatic influences that impact the ability to stay in one place (Miller & Vu, 2021), to the relatively coarse spatial and temporal resolution of currently available datasets (de Sherbinin & Bardy, 2015), and because current assessment models miss the feedbacks among the socio-economic and climate systems (Rising et al., 2022).

4.1.1 Pathways to Climate Displacement

Keenan et al. (2018), in one of the most cited works on this topic, identify three types of climate gentrification: the “superior investment pathway,” the “cost-burden pathway,” and the “resilience investment pathway.” Under the *superior investment pathway*, households move from high-risk geographies to low-risk ones in order to avoid climate hazards. This pathway is evident in Miami, Florida, for example, where price depreciation in coastal zones induce high- and moderate- income households to move into higher elevation areas, often displacing moderate- to low-income households in historical communities of color (Keenan et al., 2018). The *cost-burden pathway* describes scenarios in which only high-income households can afford to remain in high-risk but desirable (usually coastal) areas. As the cost of insurance, repairs, taxes, etc. rise, moderate and low-income households are forced to leave these areas (Knuth, 2020). In the *resilience investment pathway*, low-income households are similarly displaced as an unintended consequence of public investments in adaptation, such as green infrastructure, that lead to rising property values that price residents out (Shokry et al., 2020).

As this climate gentrification and displacement literature has developed over the past five years, researchers have further complicated these pathways, recognizing that climate gentrification is a dynamic process that varies across contexts and may result from a combination of the above "pathways” Best & Jouzi and Black et al (2022; Black et al., 2013), for example, characterize climate gentrification as “a multi-causal, multi-spatial process that involves

dimensions of both natural and human systems…[and] happens across global and regional scales spatially and from the past to future temporally." Climate change has the potential to exacerbate other forces of displacement, such as neighborhood disinvestment, rising housing costs, and extreme weather events like flooding and heat (Gregg & Braddock, 2020). For example, Li & Grant (Li & Grant, 2022) find evidence that the major factor steering Miami homebuyers to higher ground are expensive flood insurance and the historical record of flooding, rather than scientific projections of sea level rise. On the other hand, coastal residents migrate to high elevation neighborhoods like Little Haiti in Miami, a once redlined community starved of investment for decades and only now targeted for accelerated investment through tax incentive programs.

4.1.2 Climate Displacement Metrics

Researchers have used a variety of measures to understand the potential drivers of climate displacement or gentrification: disproportionate price appreciation in high-elevation areas in Miami Dade County (Keenan et al., 2018); green resilient infrastructure siting and minority population in Philadelphia (Shokry et al., 2022); low-carbon infrastructure, housing prices, the number of lower-income and non-white residents in Seattle (Rice et al., 2019); and, agent-based modeling simulation of flood hazards and the outmigration of high-income households (de Koning & Filatova, 2020).

Aune et al. (2020) move beyond these single measures and creates a gentrification index based on education level, population above the poverty limit, and median household income. The authors use the index to identify gentrification-eligible census tracts in New Orleans before Hurricane Katrina. Of these tracts, the ones that did undergo gentrification by 2010 had experienced less flooding, were at higher elevations, and were more likely to have changed from majority black to majority white, among other demographic changes. The authors conclude that "High elevation, low-income, demographically transitional areas are at highest risk for future climate gentrification (Aune et al., 2020)." This study demonstrates the importance of examining how neighborhoods' physical characteristics and gentrification pressures interact with disasters.

Tedesco et al. (2022) develop another index, the Climate Gentrification Risk Index (CGRI), from data on rental properties, evictions, socioeconomic status, and environmental risk. The authors identify two neighborhoods, one in Miami and one in Tampa, with trends that are consistent with climate gentrification. In addition to previous studies' focus on demographics and climate hazards, this analysis points to transitional land uses and flexible zoning in low-exposure areas as potential drivers of climate gentrification.

Best et al. (2023) use machine learning to categorize U.S. East Coast counties into four typologies of social, housing, and environmental vulnerability. The researchers interpret each cluster as being defined by the superior investment pathway, disinvestment, affordable development, and a mixed typology. However, they recognize that these larger-scale patterns do not reflect heterogeneity within counties (such as at the tract level), and this method cannot speak to the exact relationship between climate change and gentrification.

Melix et al. (2023) use principal components analysis to quantify displacement pressures , focusing on demographic, socioeconomic, sea-level rise, and housing. Each component represents a combination of variables (e.g., "neighborhoods with low job proximity scores and low proficiency schools"), which they use to identify neighborhoods at risk of climate displacement. They find that high-displacement risk areas in three Florida cities also tend to be inland, making them likely to receive migrants from coastal areas, and designated as opportunity zones–two factors that may accelerate climate gentrification processes and ultimately displacement.

Finally, S. K. Kim & Park (2023) demonstrate that migration is responsive to climate risk, and that this migration to lower-risk areas leads to gentrification–in this case, both the in-migration of higher-income households and the out-migration of lower-income households and people of color. Unlike previous studies, this analysis is able to causally connect climate change, migration, and displacement (rather than illustrating displacement alongside climate impacts).

4.1.3 Gaps and Opportunities

From this body of literature, it is clear that climate displacement is a context-specific phenomenon that interacts with social, environmental, and land-use patterns. Displacement can happen alongside climate change, because of climate change, and intertwined with climate change. Displacement can result in the mobility of socially vulnerable populations to areas where they are likely to be more exposed to climate risks or are more socially vulnerable because they can only access less quality housing and neighborhoods. Displacement can occur on the heels of large-scale investments in climate adaptation and resilience —ranging from green infrastructure to seawalls to buyouts. Displacement often occurs when socially vulnerable and historically marginalized populations are priced out of a neighborhood or experience cultural displacement as neighborhood demographics and character changes. The

existing research illuminates some of these aspects of climate displacement, but a more holistic measure remains necessary.

4.2 Measuring Climate Displacement Vulnerability for New York City

Tedesco et al. (2024) propose a metric that integrates socio-economic vulnerability, climate risk, evictions, and housing data to better measure the risk of climate displacement at the neighborhood level in NYC. Unlike previous climate gentrification measures, it directly speaks to the multi-dimensional factors that can inform displacement risks. To our knowledge, this is the first time that *multiple* climate hazards are studied *in conjunction* with displacement and socio-vulnerability for NYC. The CDSV is a starting point for future research on how to capture and assess the complex nature of climate displacement using multidimensional indices which are likely to lead a more robust evidence base to assess this risk in different areas of the country. Below we describe the proposed Climate Displacement Social Vulnerability (CDSV) score and assess its strengths and limitations as applied to NYC.

4.2.1 Data and methods

The proposed Climate Displacement and Socio-Vulnerability (CDSV) score for NYC (Tedesco et al., 2024) is designed to account for climate hazards, displacement risk, and social vulnerability factors based on publicly available datasets. These databases include the FEMA National Risk Index, New York City's Displacement Index, and the Social Vulnerability Index. Each is described below. The goal is to identify those areas where risk of the combination of the three factors is the highest (e.g., hotspots due to compounding effects). As such, for each climate hazard the CDSV score is computed from the linear combination of the three factors equally weighted in Equation 1

4.2.1.1 FEMA National Risk Index

The Climate Score (ClimSc) is based on a national dataset created by FEMA, the National Risk Index (NRI), to identify communities most at risk of specific climate hazards (FEMA, 2023). The NRI combines the frequency of natural hazards with social factors and resilience capabilities. Of the 18 natural hazards, the CDSV for NYC applies the NRI to evaluate the following hazard risks: 1) Coastal and 2) Fluvial Flooding; 3) Heatwaves; 4) Hurricanes and 5) Winter Weather (winter storm events in which the main types of precipitation are snow, sleet, or freezing rain). These hazards were chosen by Tedesco et al, (2024) because they have been previously identified as priority climate hazards for the City. One caution that the researchers note regarding the Climate Score (ClimSc), is that because it is based on national data set, it is not a substitute for more granular localized investigations of hazard risks that are available (see for example, NPCC4, Rosenzweig et al (2024) which presents more detailed discussion of coastal and fluvial flooding hazards). As a reference Figure 6 shows an example of the FEMA National Risk Index ranking for the five selected hazards in the CDSV for NYC.

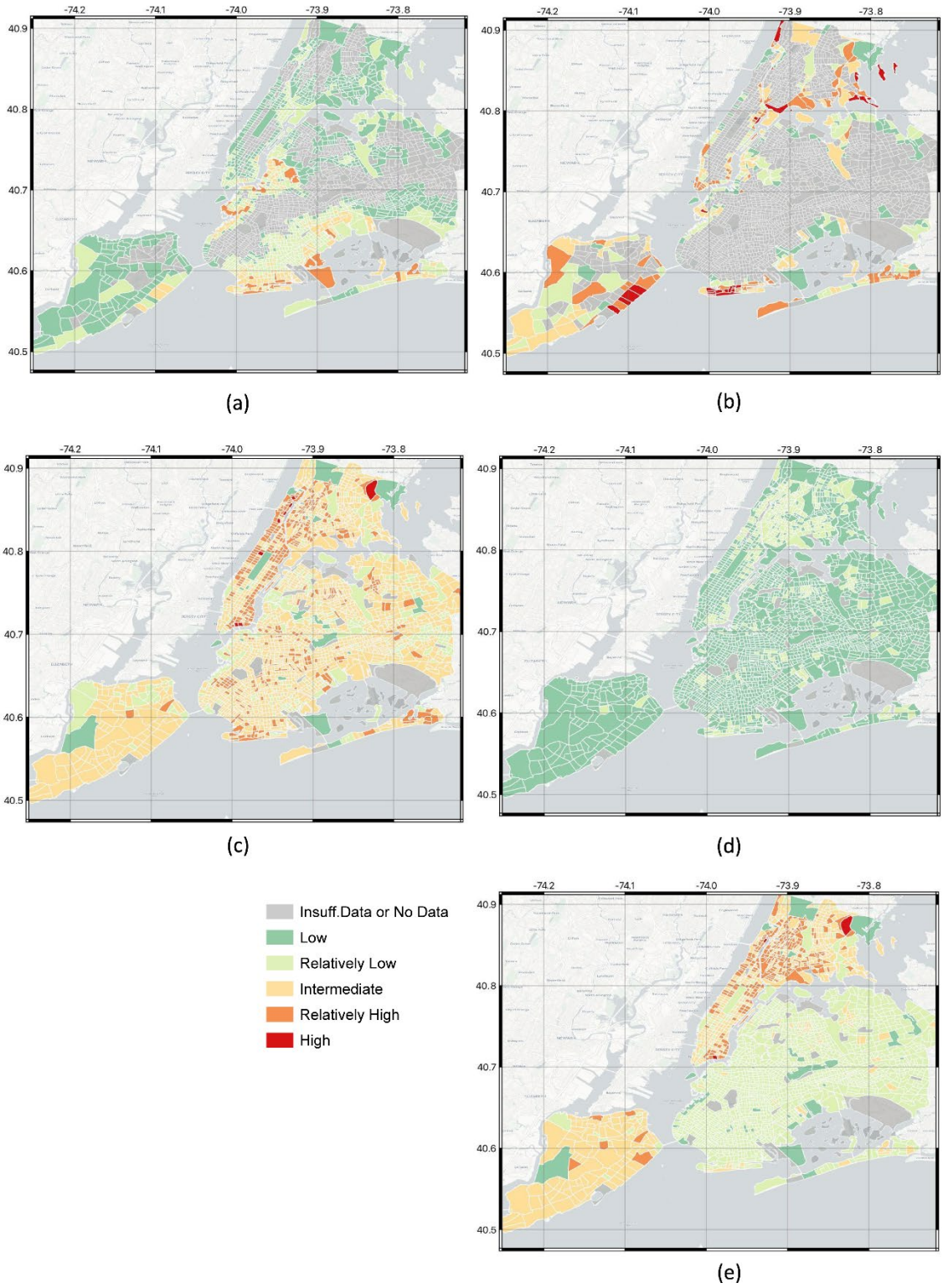

Figure 6: Risk ranking from the FEMA NRI dataset over NYC for the a) coastal flooding, b) riverine flooding, c) heatwaves, d) hurricanes and e) winter weather. Source: FEMA National Risk Index

4.2.1.2 NYC displacement risk dataset

The Displacement Score (DispSc) is constituted from displacement risk data obtained from the NYC Department of City Planning (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023). NYC defines displacement as the "involuntary movement of an individual or family from their home or neighborhood, whether as the result of eviction, unaffordable housing costs, or poor-quality housing". The NYC displacement risk builds on variables listed in Local Law 78 (Local Law 78, 2021), which requires an online citywide equitable development data tool including data from six categories, disaggregated by race and ethnicity. Specifically, the Displacement Index uses three categories of data: Population Vulnerability, Housing Conditions, and Market Pressure. Population Vulnerability refers to the demographic and socioeconomic characteristics of a neighborhood's residents that may make them more susceptible to displacement. It includes factors such as race/ethnicity, income, and the share of a household's income spent on rent. Housing Conditions refer to the characteristics of housing in a neighborhood that can either help stabilize households or lead to greater instability. It includes variables such as the condition of the housing stock, whether a household rents or owns, and applicability of various programs or regulations limiting rent increases. Market Pressure refers to the broader conditions affecting neighborhoods that tend to make it harder for lower-income residents to remain or find new housing in the area and includes data points related to changes in the housing market and demographic composition of a neighborhood, among others.

The data is generated at the Public Use Microdata Area (PUMA) scale, a statistical area defined by the US Census (United States Census Bureau, 2023c). PUMAs in NYC generally approximate Community Districts, of which there are 59 (Tedesco et al., 2024). The Displacement Risk Map, which is not broken down by race and ethnicity, is generated at a smaller geography, Neighborhood Tabulation Areas (NTA) (City of New York Department of City Planning, 2023a). NTAs are groupings of census tracts that are designed to approximate neighborhoods. The index is obtained through the incorporation of several data sources that are surveys, such as the American Community Survey (ACS) (United States Census Bureau, 2023a) and the Housing and Vacancy Survey (HVS) (United States Census Bureau, 2023b), meaning the data are based on a sample and there is a margin of error (MOE) associated with each data estimate. As an example, Figure 7a shows the displacement risk used in this study. As in the case of FEMA NRI, the CDSV score for NYC converts the displacement risk categories into numerical values using the following correspondence: Very Low = 0; Relatively Low = 25; Intermediate = 50; Relatively High= 75; Very High= 100. We name this the Displacement Score (DsipSc).

4.2.1.3 SOVI

For the socio-vulnerability score (*SOVISc*) the CDSV uses the Social Vulnerability Index (SoVI) (Cutter et al., 2003). The index synthesizes 29 socioeconomic variables, which the research literature suggests contribute to reduction in a community's ability to prepare for, respond to, and recover from hazards. The data are compiled and processed by the Hazards and Vulnerability Research Institute at the University of South Carolina and are standardized and placed into a principal components analysis to reduce the initial set of variables into a smaller set of statistically optimized components (*HVRI Data and Resources - College of Arts and Sciences | University of South Carolina*, n.d.). The CDSV normalizes the SoVI score value between 0 and 100 over the NYC area (Figure 7b).

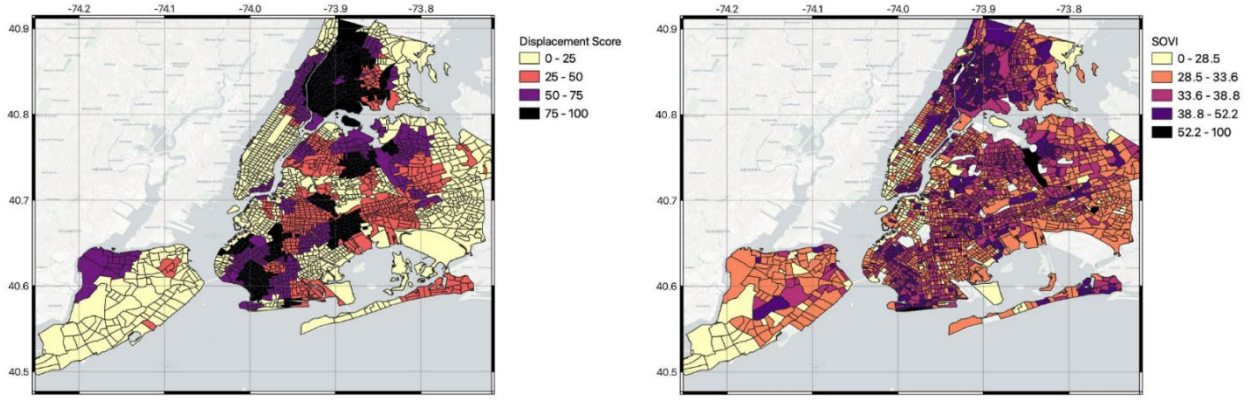

Figure 7: Displacement (a) and SOVI (b) scores over NYC. The SOVI score is normalized to the NYC values.

4.2.1.4 Computation of the Climate, Displacement and Socio-Vulnerability (CDSV) score

For each climate hazard e the CDSV score is computed from the linear combination of the three factors equally weighted in Equation 1 (Tedesco et al., 2024):

$$\mathrm{CDSV_i} = (\mathrm{ClimSc_i} + \mathrm{DispSc} + \mathrm{SOVISc})/3$$

Equation 1: Climate, Displacement and Socio-Vulnerability (CDSV) Score. V_i is the specific natural hazard. DispSC is displacement score based on the NYC Displacement Risk dataset. SOVISc is SOVI score based on (Cutter et al., 2003).

The subscript *i* refers to the specific natural hazard (e.g., coastal flood, heatwaves, etc.). The $\mathrm{CDSV_i}$ score can range between 0 and 100 with 0 being the lowest impact due to the combination of the three factors and 100 being the highest (Tedesco et al., 2024). The CDSV is also complemented by a Climate Displacement and Socio-Vulnerability Rank (CDSV_R) obtained by translating the numerical values into categories using k-means classification (Wu, 2012) and adopting the five different classes of *Very Low*, *Low*, *Intermediate*, *High,* and *Very High* (Tedesco et al., 2024).

4.2.2 Results

Figure 8 shows the CDSV scores obtained for coastal (a) and fluvial flooding (b) heatwaves (c) hurricanes (d) and winter weather over NYC (Tedesco et al., 2024). Figure 9 shows the relative contribution of socio-vulnerability (left column), displacement (middle column) and climate hazards (right column) to the CDSV in the case of the different climate hazards. Values can range between 0 and 1, with low values meaning that the particular factor under consideration weakly contributes to the CDSV and high values meaning that it is a dominant contributor. These figures illustrate, for example, a relative minor role over most of our study areas in the case of hurricanes (Figure 9 j, k, and l) where the socio-economic component plays a large role in south Staten Island and the Lower East Side of Manhattan. In contrast, in the case of heatwaves, all three factors tend to contribute to the computed CDSV in a more balanced way (Figure 9 g, h, and l), with displacement playing a negligible role in lower Manhattan and the climate factor playing a larger role in mid-Manhattan and, again, the southern portion of Staten Island.

In order to better identify the location of the areas at highest risk of exposure to the combination of climate, displacement, and socio-vulnerability factors, Tedesco et al (Tedesco et al., 2024) ordered the top 10 CDSV values for the five hazards. The tract with the highest occurrences of top 10 CDSV values is located along Harlem River Drive, near the subway station on 155th street. The 2016 Census (American Community Survey) reports 7,601 people for this tract with an unemployment rate of 27.7%, a poverty rate of 49.3 %, a per capita income (PCI) of $10,982. 34 % of the residents don't have a high school diploma, 30.2 % are younger than 17 years, 31.8 % are single parents and 99.8 % belong to a minority, with 85.3 % of the population not having a vehicle. As a comparison, the NYC average values for the same quantities are: 19.4 % (no high school diploma), 21.1 % (younger than 17 years), 10.7 % (single parent), 67.4 % (minority) and 43.4 % (no vehicle).

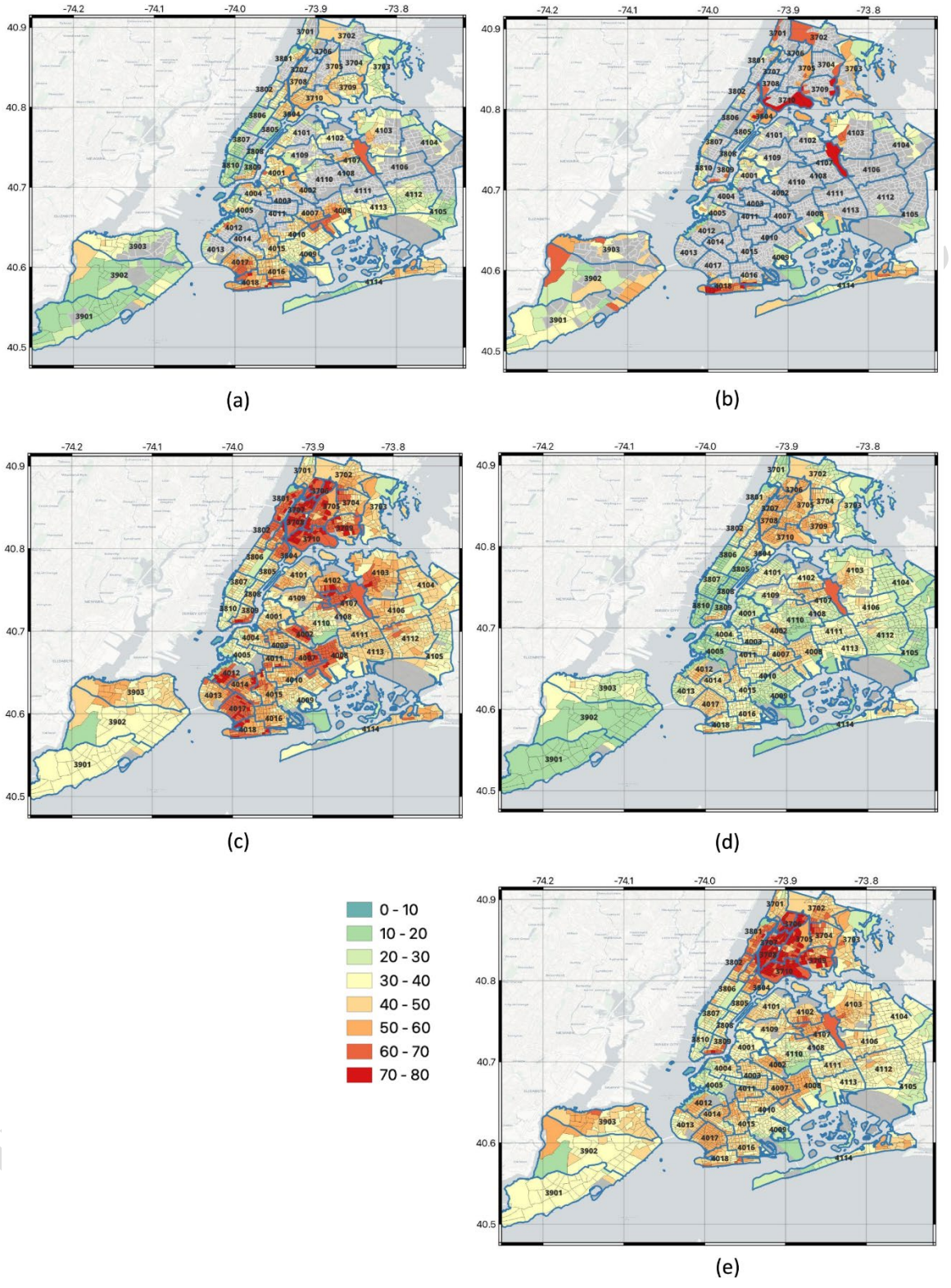

Figure 8: CDSV score for a) coastal and b) riverine flooding, c) heatwaves, d) hurricanes and e) winter weather for the five NYC boroughs. Thick lines and numbers represent PUMA areas and their extent.

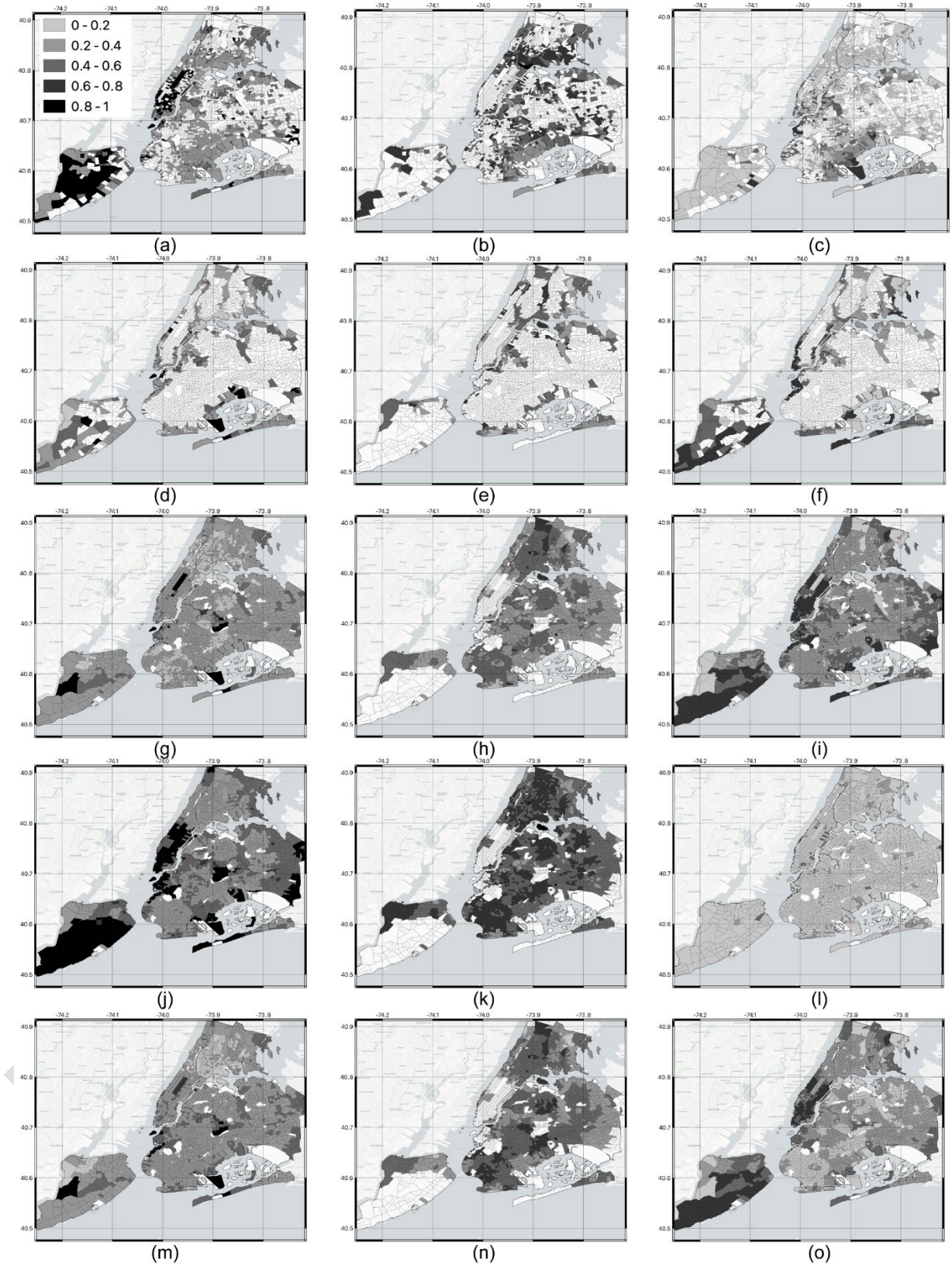

Figure 9: Relative contribution (ranging from 0 to 1) of the socio-vulnerability (first column), displacement (mid column) and climate hazards (right column) in the case of coastal (a,b,c) and riverine (d,e,f) flooding, heatwaves (g,h,i), hurricanes (j,k,l) and winter weather (m,n,o) to the computed CDSV score.

The second-highest ranked tract is located in the Bronx, containing the 182-183rd street subway station and it is home to 4,142 people. The PCI is $11,675, and more than half of the population (52.4 %) live below the poverty line. Similar to the case of the Ralph J Rangel Houses, roughly 30 % of the population is younger than 17 years of age with 82.2 % not having access to a vehicle. Also, as in the previous case, 99.3 % of the population belongs to a minority, 91 % lives in multi-unit, and 31.9 % has limited English skills, with 39.2 % not having a high school diploma.

A second tract ranked highly, according to CDSV top 10 values, is located in southeast Manhattan. This area is home to 10,765 people (according to the 2016 Census) of which 10.7 % are unemployed, 49.8 % have no high school diploma, 26.3 % are over 65 years of age, and 17.9 % are below 17 years of age. The PCI here is slightly higher than the other places, being $14,554 and with a percentage of 39.3% of the population who live below the poverty line. Similar to other areas ranking high in terms of combined top CDSV values overlapping from multiple hazards, 95.6 % of the population belongs to a minority, 81.2 % have no vehicle, and 43.8% speak limited English.

The census tract located in south Brooklyn (also within the top CDSV score) contains 2,460 people. The relative percentage of people belonging to a minority is smaller than in the previous cases (43.9 %) with the percentage of people living below the poverty line down to 27.3 % and a PCI of $22,011, almost doubling the one found for other areas discussed above. Here, the percentage of people with disabilities is relatively high (34.9 %), and so is the percentage of people older than 65 years of age.

The last tract where the CDSV has three top 10 values is located along Brighton Beach. This tract hosts 4,062 people with a PCI of $17,489, an unemployment rate of 15.7%, and a percentage of minority of 12.1%. Here, more than one third (37.2 %) of people are 65 years or older, and only 13.4% are younger than 17 years. The percentage of people with no high school diploma is relatively low (9.1%), but the percentage of people speaking limited English is relatively high (49.8%).

Building on data provided by the NYC's Mayor Office concerning changes in socio-economic and housing conditions for three different periods (2000, 2008-2012, and 2015-2019) (City of New York Department of City Planning & City of New York Housing Preservation and Development, 2023), Tedesco et al (Tedesco et al., 2024) additionally analyzed how such conditions have been changing for those areas where relatively high values of CDSV were obtained in order toto understand some of the socio-dynamic processes associated with or driving the combined risk of climate hazards and displacement and the populations at risk. To further this understanding, the study grouped the CDSV scores into 5 classes using a K-means based approach (Wu, 2012) and refer to the 5 classes as Very High, High, Intermediate, Low and Very Low.

Focusing the attention on those areas classified as Very High and High, for example, the study identified the following PUMA regions: # 3705 through #3710 in the South Bronx; # 4017 in South Brooklyn, # 4012 in Southeast Brooklyn, and # 4008 in Queens. The areas in the South Bronx showed a decrease in the Median Home Value between 2008-2012 and 2015-2019 up to more than 10 % (e.g., 3705 Figure 10) and a corresponding increase in rent of the same order of magnitude. These areas are characterized by a high percentage of Latin/Hispanic people (on average above 65 %). For the inland areas, the Latinx/Hispanics population has increased up to ~ 10 %, with the increase being smaller for the regions along shorelines (e.g., 3710). For some of the PUMA sectors, such as # 3706, the percentage of White people halved between 2000 and 2018 (from 11 % to 5.6 %) where for the PUMA # 3707 and 3708 the percentage of African Americans has reduced by 6-8 %. The increase in rent and the decrease in home values point to an increased financial stress for the already vulnerable populations living there.

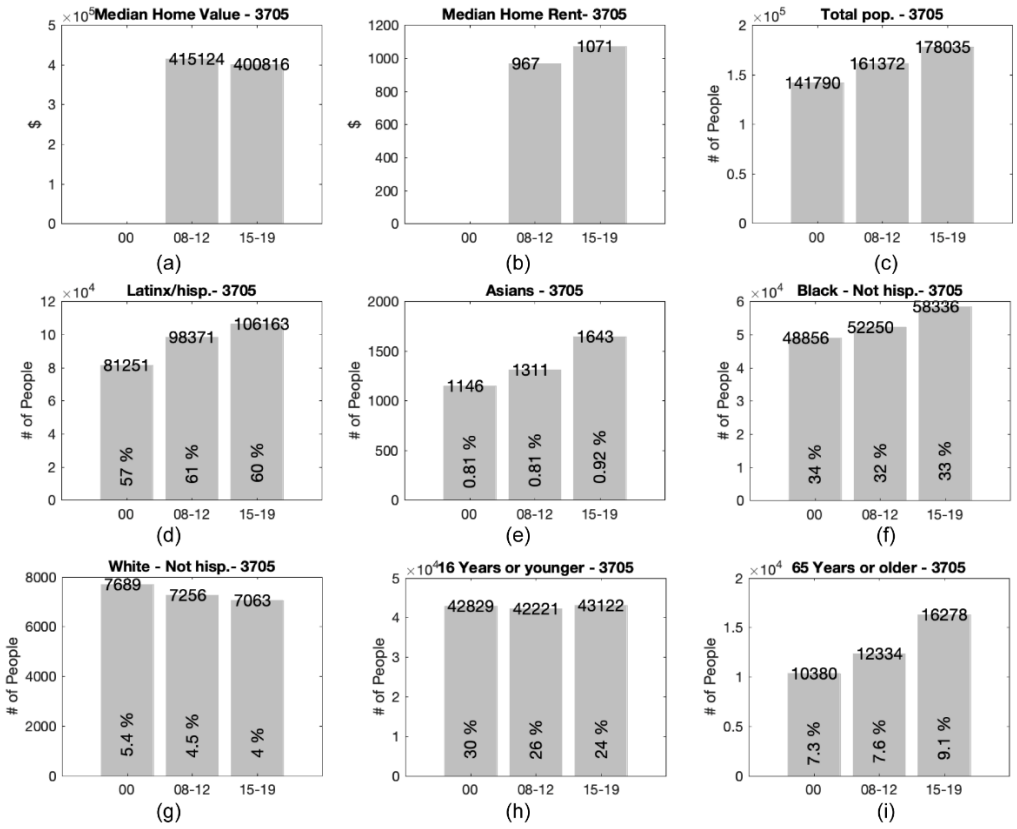

Figure 10: Changes in a) Total population, b) number of Black-Not Hispanics, c) Latinx/Hispanics, d) Asians, e) Whites, f) people who are 16 years or younger , g) people who are 65 years or older, h) Median Home Value and i) Median Home rent for the years 2000 , 2008-2012 and 2015-2019 for PUMA 3705. Percentage values within the gray bars in panels b through g represent the relative percentage of the population for the corresponding class with respect to the total population.

The PUMA sector in South Brooklyn (4017) shows, differently from the South Bronx areas, an increase in both the median value and the rent. The median value increased by roughly 20 % between 2008-2012 and 2015-2019. The increase for rental was a similar order of magnitude. For the PUMA #4017, the Latinx/Hispanic population has doubled from ~ 8 % in 2000 % to 16 % in 2015-2019 of the total population, similarly to Asians, whose percentage increased from 23 % in 2000 to 43 % in 2015-2019. For the same region, the number of White people drastically reduced from 65 % of the population in 2000 to 36 % in 2015-2019.

In the case of PUMA # 4008 the median home value did not considerably change between 2008-2012 and 2015 – 2019, with a relatively small increase in the median home rent. In this area, the study noted an increase of the Asian population, which tripled in terms of the number of people and doubled in terms of percentage relative to the total population. Such increase is even more substantial for PUMA #4012, in Southeast Brooklyn, showing almost doubling of Asians (from ~ 30,000 to ~ 55,000) with a change in the relative percentage from 22 % to 36 %. Differently from PUMA #4008, however, the studied noted a substantial increase in the median home value by 27 % from the period 2008-2012 to the period 2015–2019.

The study also investigated the relationships between the CDSV and racial, ethnic, and health factors to study potential linkages that could provide suggestions for future policies or recommendations. These included health data (e.g., number of adults with asthma and diabetes) and racial/ethnicity data obtained from the recently released Climate and Economic Justice Screening tool (Executive Office of the President of the United States Council on Environmental Quality, 2023) and spatially co-registered with the CDSV scores at census tract level. In the case of riverine flooding, the study observed a systematic decrease of the median value of the percentage of White people as the CDSV score increases. This is accompanied by a significant increase of the percentage of Latin/Hispanic people and also Black people.

In the case of heatwaves, the median value of the percentage of White people is minimum for low CDSV values, reaching a peak in the case of CDSV binned values between 30 and 40 and dropping considerably after reaching a

CDSV value close to 0. In the case of Latin/Hispanic people, the computed median values begin to increase after the CDSV binned values of 30-40. An increase is also observed in the case of Black people for this hazard.

Similar results were observed in the study for areas affected by hurricanes, winter weather, and heat wave outcomes showing the median value of the percentage of White people belonging to high CDSV values decreasing with CDSV scores and the percentage of Latin/Hispanic and Black people increasing, with the Latin/Hispanic people reaching the highest values.

The study observed more generally that the relationship between CDSV and the median value of the percentage of people belonging to racial/ethnic classes are not statistically significant in the case of coastal flooding. This is also true in the case of White people and heat waves CDSV score. The remaining cases showed statistically significant associations between median values and binned CDSV score (either at 95% or 99 % level). It is important to note that Tedesco et al. (Tedesco et al., 2024) focus on exploring linear relationships between the values reported on the y axes and those on the x axes of the different panels. Exploring other non-linear formulas, such as quadratic or polynomial of higher grade, might unveil other relationships that cannot be discovered with the linear approach, though it would require a deeper understanding of the processes driving such relationships to avoid the risk of overfitting the model to achieve a higher correlation without considering causality.

The percentage of White people exposed to CDSV riverine flooding and winter weather decreases, respectively, by 1.3 % (riverine) and by 1.12 % (winter weather) per CDSV value. The percentage of Black people increases with increasing CDSV values for all hazards but coastal flooding, with hurricanes showing the largest increase (1.35 %/CDSV), followed by riverine flooding (0.52 %/CDSV) and winter weather (0.34 %/CDSV) and heatwaves (0.37 %/CDSV). In the case of Latin/Hispanic people, the only negative trend (-0.92 %/CDSV) is found in the case of hurricanes. Trends are similar in the case of winter weather (0.99 %/CDSV) and heatwaves (0.84 %/CDSV), with a relatively lower value in the case of riverine flooding (0.66 %/CDSV).

Finally, in view of the compounding effects of heatwaves and health (Madrigano et al., 2015), which can lead to deteriorating health conditions or premature mortality, the study also analyzed the relationships between the CDSV in the case of heat waves and the number of people diagnosed with asthma and with diabetes. In both cases, the study observed a strong relationship between the CDSV computed values and the median number of people diagnosed with the two illnesses. This points out the potential risks of compounding effects on health for those who already have such conditions in areas where the combination of climate, displacement, and socio-vulnerability is the highest. The correlation coefficients between CDSV Heatwaves and median values of people above 18 years of age with asthma and diabetes are $R^2 = 0.82$ (asthma) and $R^2 = 0.92$ (diabetes), both statistically significant at a 99% level ($p<0.01$). In the case of the two illnesses considered here, we find an increase of 97.1 (diabetes) and 56.5 (asthma) people per CDSV value.

4.3 Conclusion and Limitations

As reported, Tedesco et al. (Tedesco et al., 2024) developed a Climate, Displacement, and Socio-Vulnerability (CDSV) score for multiple climate hazards (coastal and fluvial flooding, heat waves, hurricanes, and winter weather) over NYC. Following Tedesco et al. (2022), the researchers based the scores on publicly available datasets provided by FEMA, the NYC Dept. of City Planning, and the University of South Carolina. The score captures the relative contribution of climate hazards, displacement risk, and social vulnerability to the total score over the different areas of NYC and the ways that socio-economic and demographic conditions have changed starting in 2000 for those areas where the compounding effect of multiple risks and hazards is the highest. Such areas are located in the South Bronx, South Brooklyn, and Queens.

The study also quantifies linkages between the CDSV scores for the different climate hazards and health as well as for racial/ethnic indicators. The results indicate that, except for the case of coastal flooding, the percentage of White people decreases as CDSV scores increase where the percentage of Black and Latin/Hispanic people increases, with the latter showing the strongest correlation. The results also show a statistically significant relationship between the median number of people with asthma and diabetes and the CDSV score in the case of heat waves.

Given the results reported, the CDSV score might be used by the City to help inform decision-making about climate investments that account for both socio-economic vulnerability and displacement. It contains the potential to help guide where and how to target adaptation strategies and resilience investments to avoid or reduce the chance of maladaptation outcomes and climate gentrification (Tedesco et al., 2024). Importantly, the results demonstrate that the sensitivity of the population to the combination of climate hazards, displacement, and socio-vulnerability has been increasing over the past decades because of the evolution of socio-demographic factors and to the geographic regions where the combined effect is the highest. There appears to be a strong correlation between people

belonging to specific racial and ethnic groups and the combined effects of the three factors accounted for in the scores, highlighting the racial reverberations of climate change impacts on those groups who are already carrying the burden of social and racial segregation. This is also true for illnesses such as asthma and diabetes, reinforcing the inter-generational climate justice aspect of climate change, with areas where the combined impacts are greater being home to a high number of ill people.

The proposed CDSV score and methodology, however, do contain limitations that can be addressed through further research. One limitation consists of the use of the specific datasets used in this study. First, as previously mentioned, the datasets used by FEMA to generate the NRI database are limited relative to what is known about some of the climate hazards, such as flooding, in NYC. The city can and should utilize climate data generated for this Report that is more specific regarding different types of flooding, for example, through the use of datasets at enhanced spatial resolution and accounting for local events that are missing from the NRI. This more granular data might improve the understanding of the spatio-temporal behavior of the CDSV. Similar granularity for the socio-vulnerability dataset would be valuable as well, akin to the recommendations made in the NPCC3 report to utilize specific SOVI indicators to better assess neighborhood vulnerability in NYC. In this regard, a revised version of the FEMA NRI which now includes the SOVI dataset and an analysis of the CDSV values obtained using the two distinct socio-vulnerability datasets would be a useful exercise to understand the robustness of the results reported in Tedesco et al.(Tedesco et al., 2024) and here discussed. Similarly, one drawback of incorporating all 29 SOVI indicators with New York City's displacement index is the likelihood of duplication in some of the vulnerability metrics. A more fine-tuned analysis, making use, for example, of Principal component Analysis (PCA) might reduce or eliminate the risk of duplication. Nevertheless, this is not straightforward as it is not clear how the socio-vulnerability terms are used by the City to generate the displacement index as we were not able to obtain such information. Finally, the study authors note that the assessment of their results in terms of margins of error (MOE) was not performed given the absence of MOEs with the currently available FEMA NRI. Although the FEMA NRI team is currently working to build this, and preliminary validation is underway using historical period, the authors note that the results reported in Tedesco et al.(Tedesco et al., 2024) might be relatively robust in terms of errors, given that most of the analysis is focused on the areas with the top CDSV values.

5 Best Practices for Climate Adaptation Planning and Investment

There are significant links between climate risks, adaptation investments, housing, socio-economic inequalities, and residential mobility (Section 4), that shape the equity outcomes of municipal resilience and recovery projects. Climate impacts and resiliency measures cannot be examined in isolation from other processes at play in a community. Because of this complexity, there is no singular approach to equitable climate resilience that is broadly applicable to NYC. Instead, diverse, multiple, and overlapping approaches must be developed with local input to adapt to the unique context of each community.

In a review of the literature relating to equitable climate adaptation planning, two general themes emerge as central to achieving equitable climate adaptation: community-driven climate resilience planning and approaches should be prioritized over traditional top-down, government or private sector led initiatives (Binder & Greer, 2016; Shokry et al., 2020). This sentiment was echoed in the interviews conducted with climate resiliency experts and city officials. Interviewees highlighted the importance of community engagement in every step of the process including the design of climate resiliency proposals. In addition, since a major concern of climate resiliency initiatives is the risk of displacement, multiple studies highlight infrastructure investments, particularly affordable housing, as a necessary component of equitable resiliency efforts (Rice et al., 2019; Shokry et al., 2020, 2022).

There is a diversity of innovative approaches to equitable and just climate resilience in NYC, throughout the region and globally. Since climate justice entails addressing intersecting systems that drive climate change and inequality, the responses must also reflect a depth and richness capable of attending to these multiple, interrelated systems. In addition to a review of the literature, this section is informed by insights from semi-structured interviews conducted with representatives from NYC-based environmental justice groups, including Sonal Jessel (Director of Policy) from WE ACT for Environmental Justice, Elizabeth Yeampierre (Executive Director) and John Fleming (Development Director/Project Manager) of UPROSE, Rami Dinnawi (Environmental Justice Campaign & Policy Manager) and Daniela Castillo (Program Manager, Green Light District) of El Puente, and Eddie Bautista (Executive Director) of NYC Environmental Justice Alliance. Many of the organizations and climate adaptation strategies that are described herein are also featured in the literature focused on case studies of just climate adaptation and resiliency planning. The following best practices can help guide climate adaptation planning and investment. The practices are designed to be illustrative, not prescriptive, enabling city governments, community groups, and other stakeholders to tailor them to their individual contexts.

5.1 Integrative Approaches to Climate Resilience

5.1.1 Seeking economic development opportunities that advance just transitions and adaptive economies

Climate resilience comprises not only physical protection from climate risks but also social and economic resilience in the face of disruption. Adaptation planning and infrastructure investments can serve as opportunities to strengthen local economies, make them more inclusive, and promote regenerative industries. A just transition approach to climate adaptation considers the overlapping opportunities for wealth generation and promotion of health and well-being, equitable access to renewable energy, and affordable, efficient homes (Sze & Yeampierre, 2017). One example of a just transition approach is the growing interest in "adaptation economies" sometimes also referred to as a green economy. Adaptation economies build on the need for adaptation investments, from workforce development to supply chain manufacturing, across multiple sectors and infrastructures. These investments can be leveraged by vulnerable communities to address legacy environmental and economic injustices as well as future climate risks.

People United for Sustainable Housing **(PUSH Buffalo)**, for example, is developing a 25-square block in Buffalo's West Side, focused on green and affordable housing, vacant land use, and quality jobs to build a "resilient and regenerative community." PUSH Buffalo created this Green Development Zone (GDZ) in 2008, and their neighborhood-scale work continues to enhance and preserve the community's local economy in a self-sustaining way, demonstrating how short-term community development opportunities can create green sectors and workforces that thrive in the long term. PUSH prepares people to work with development partners and a network of local contractors, and they directly employ local workers through their related enterprises, PUSH Blue and PUSH Green. PUSH's projects are designed to promote physical resilience–including green infrastructure installation, residential weatherization, and retrofits–while creating a thriving local economy (Hart & Magavern, 2017).

Similarly, **UPROSE**'s Green Resilient Industrial District (GRID) Plan aims to invest in green industries and job training for low-income residents of Sunset Park, securing this economic base for a neighborhood that faces both climate and economic challenges (E. Yeampierre, personal communication, February 17, 2023). The GRID plan has already secured important public (i.e. NYC EDC) and private sector (i.e. Equinor) investments to implement economic revitalization programs tied to the port and job training tied to the offshore wind industry (Nguyen & Leichenko, 2022). Public and private investments coupled with community-based plans can produce multiple benefits for climate adaptation goals.

Climate resilience investments can also bring new industries to environmental justice communities, with the potential to address legacy pollution while creating new economic opportunities (Shi, 2021). In NYC, the **NYC-EJA** and **UPROSE** are part of a coalition advocating for the city to replace nearby peaker plants with renewable energy battery storage facilities. NYC-EJA has also been in discussion with El Puente regarding peaker plant retirement strategies in their neighborhood and Brooklyn Community Board 1 (R. Dinnawai & D. Castillo, personal communication, June 14, 2023). This could create jobs, but a community-led strategy is necessary to ensure that residents are able to benefit from the new industry and do not lose waterfront access in the process (Bautista, Hanhardt, et al., 2015). Internationally, the **European Union**'s "Clean Energy for All Europeans" package promotes renewable energy communities and citizen energy communities in part to address energy poverty and inequity (Directive (EU) 2018/2001 of the European Parliament and of the Council on the Promotion of the Use of Energy from Renewable Sources, 2018; Directive (EU) 2019/944 of the European Parliament and of the Council on Common Rules for the Internal Market for Electricity, 2019). Within this enabling policy environment, cities and local institutions can advance decentralized energy models, helping to create not only local jobs but also new income sources for residents. The cities of Rome and Paris are both experimenting with programs to support solar communities and eco-districts (Government of the City of Rome, 2022). The city of London created a Community Energy fund to facilitate access to funding for creating renewable energy communities in vulnerable neighborhoods (Mayor of London & London Assembly, 2023).

The United States has experimented with community solar, which has shown some of this potential but also raised questions around channeling benefits and opportunities to marginalized communities. The **Institute for Local Self-Reliance's Community Power Map** (2016) illustrates how much community solar efforts depend on a robust state and local policy enabling environment.

NYC has some promising investments in solar that have produced economic, environmental, and public health benefits for vulnerable communities. For example, **UPROSE** partnered with the MTA to secure a 685-kilowatt cooperatively-owned solar project with 200 residents, and WeAct trained and hired 100 residents in the installation of 415 KW of solar in public housing (E. Yeampierre, personal communication, February 17, 2023).

5.1.2 Designing adaptation strategies to maximize co-benefits and address multiple challenges within a community

Beyond economic development, adaptation planning has the potential to benefit communities more broadly. By intentionally harnessing planning processes and investments to advance what communities want and need climate adaptation can contribute to more livable places in a holistic way (Rudge, 2020). Adaptation strategies should address multiple challenges within a community, such as public health promotion, community infrastructure (e.g., parks and public spaces), and affordable housing.

In **Edgemere, Queens**, the City's 2017 Resilient Edgemere Community Plan (RECP) (City of New York Department of Housing Preservation and Development, 2017) aimed to leverage disaster recovery and other funding to make improvements to the neighborhood. The Plan incorporated a number of strategies for developing and managing new affordable housing, commercial/residential mixed-use, and open space in the neighborhood (City of New York Department of Housing Preservation and Development, 2017). For example, the Plan incorporates a Community Land Trust (CLT) model for over 100 vacant lots owned by the City to support different land uses with the goal to "work with local organizations to develop a model for community ownership to facilitate long-term affordability and resilient land stewardship" (Change Capital Fund, 2023; City of New York Department of Housing Preservation and Development, 2021).

Public health is often a primary co-benefit of climate adaptation. For example, **WE ACT** has created a 2022 Extreme Heat Policy Agenda to address extreme heat and its associated health risks (S. Jessel, personal communication, August 23, 2022).Whether addressing rising temperatures or any other climate risk, resilience policies are also public health policies.

In addition, many green development projects can take on community uses, such as **PUSH Buffalo** converting vacant lots into community gardens and developing abandoned buildings into affordable housing and commercial spaces (Hart & Magavern, 2017). This work generates a wide range of benefits, such as vacancy reduction, home insulation, and improved food access, among others.

Moreover, the benefits may be essential to placemaking and place-keeping, even when they are not measurable; for example, **El Puente** envisions using green infrastructure to create public spaces that can help root communities in the face of displacement pressures (R. Dinnawai & D. Castillo, personal communication, September 23, 2022). They apply four key principles in the review of green investments: (1) fosters community congregation, (2) reflective of community culture, (3) establishes a sense of connection to a place and its people (i.e. history), and (4) cultivates collective care in the maintenance of green spaces (R. Dinnawai & D. Castillo, personal communication, September 23, 2022).

5.2 Community-Driven Planning Processes

5.2.1 Understanding the local context and history and the role of land-use patterns

Understanding context and history is important not only to serve the community more effectively but also to make adaptation plans more successful in the face of intersecting housing and climate displacement risks. Without this background, planning processes risk perpetuating past harms and missing critical information. As Shokry et. al. (Shokry et al., 2020) explain, community-driven adaptation approaches "can be responsive in real time to social-ecological processes and ensure that benefits belong to vulnerable residents."

In **Edgemere, Queens**, the City's Resilient Edgemere Community Plan recognized the significant role of past racism and disinvestment in creating the conditions for social vulnerability, which sea-level rise now compounds. Similarly, **El Puente** has advocated for the closure of certain ramps on the Brooklyn-Queens Expressway (BQE) for adaptation initiatives, directly connecting the history of racist infrastructure development with resilience today (R. Dinnawai & D. Castillo, personal communication, September 23, 2022).

However, history does not just help explain current challenges and conditions; it also points to community assets and strengths. For example, the **New York City Environmental Justice Alliance (NYC-EJA)** continues to advocate for the equitable preservation of "working waterfronts" in environmental justice communities (some of these working waterfront parcels are referred to in NYC as "Significant Maritime Industrial Areas" (or SMIAs)). While NYC-EJA has successfully championed better environmental and climate protections for SMIAs since the 1990s, they have also understood the critical need to retain "working" (or industrial) waterfronts for their significant potential as clean renewable energy hubs and other sustainable infrastructure investment options, climate adaptation opportunities and the presence of local economic development bases for adjacent underemployed Black and Brown local communities (Bautista et al., 2014). For example, while the majority of these SMIAs fall within floodplains, maintaining SMIA zoning while imbuing resiliency measures in these areas is key to protecting against climate risks like flooding while

providing an economic base for local residents that helps also prevent future housing displacement. A good example of this approach is **UPROSE**'s Green Resilient Industrial District (GRID) Plan (UPROSE, 2023), which preserves the industrial nature of the waterfront--understanding the importance of this manufacturing history in shaping the future of green manufacturing–and how Sunset Park residents will be a part of it.

Consideration of both past and future land use zoning and development patterns will be critical for ensuring new developments don't further exacerbate inequalities as well as climate and displacement risks. Waterfront developments in places like Harlem, Sunset Park, Edgemere, and other EJ communities were identified as important sites for equitable climate adaptation and planning processes that consider the effects on housing as well as climate protections. For example, the Hazard Mitigation Zone, a zoning tool used by the City to restrict land parcels from future development, was implemented in the north side of **Edgemere** and coupled with the development of Community Land Trust (CLT) as a way to address affordable housing concerns (Change Capital Fund, 2023). But there are floodprone waterfronts throughout the city that are actively being developed for market-rate housing that can exacerbate displacement and flooding risks.

5.2.2 Going beyond community engagement: community-led processes

Community members (including but not limited to residents) should have a direct, meaningful say in the decisions that affect them—from the start and on an ongoing basis in climate adaptation.

In **Edgemere**, community engagement was a part of creating the Resilient Edgemere Community Plan (City of New York Department of Housing Preservation and Development, 2017). However, residents continued to voice concerns about the voluntary buyout program that the Plan recommends (Kensinger, 2017). In this case, the community developed its own vision for a just resiliency plan reflected in the report entitled "Community Visioning for Vacant Land Following Managed Retreat in Edgemere, Queens, N.Y." (See RISE, (Seip, 2022)).

Fortunately, alternatives to traditional engagement models are available, such as the community planning congresses that directly shaped Buffalo's Green Development Zone. By centering community members' voices, **PUSH Buffalo** was better able to identify development and environmental priorities that could respond to immediate challenges, increasing buy-in and making the Zone more successful (Hart & Magavern, 2017) even when this type of community-driven planning was not possible during the COVID-19 pandemic.

UPROSE adapted their climate justice organizing, experimenting with learning circles and social media to re-engage residents in efforts to strengthen social cohesion (E. Yeampierre, personal communication, February 17, 2023). This approach focuses on survival strategies, ancestral knowledge and community priorities such as renewable energy, clean water, food sovereignty, and wellness (E. Yeampierre, personal communication, February 17, 2023). No matter which engagement tools are used, the uptake of adaptation solutions depends on community buy-in, which starts with community-led decision-making (Rudge, 2020, 2021).

5.3 Collaborative Development of Goals, Programs, and Policies

5.3.1 Developing a shared vision with buy-in from government leaders and leveraged investments

A shared vision helps community members, local groups, partners, and city governments efficiently work toward the shared climate adaptation goals. This buy-in also facilitates the flow of funding from governments to communities, and of essential information from communities to policymakers (Baptista, 2024).

Several of the New York environmental justice groups profiled are part of coalitions with local and state policy agendas. By working collectively, these groups can build political will for climate solutions that invest in the most impacted communities. Their work has contributed to legislation such as the statewide Climate Leadership and Communities Protection Act (New York State Climate Leadership and Community Protection Act, 2019).

One of the most powerful strategies that many EJ organizations employ for equitable climate adaptation is coupling policy advocacy with the implementation of climate adaptation measures and targeted investments in the most vulnerable communities. For example, groups like **NYC-EJA** and **WE ACT** supported the adoption of Local Law 97 and focused on investments in job training and economic opportunities for vulnerable residents to help upgrade buildings as part of the implementation of this important climate mitigation policy (E. Bautista, personal communication, November 10, 2022; S. Jessel, personal communication, August 23, 2022).

As a membership network, **NYC-EJA** helps to foster this cohesion by connecting environmental justice grassroots organizations in developing innovative environmental and climate solutions (New York City Environmental Justice Alliance website (New York City Environmental Justice Alliance, 2023). This was particularly critical when NYC-EJA created their New York City Climate Justice Agenda, an annual analysis of NYC climate policies and initiatives,

accompanied by grassroots solutions designed to reduce racial disparities and climate vulnerabilities. For partnerships and coalitions to effectively work together, communicating clear and aligned priorities can then inform higher-level agenda-setting for government agencies and legislation.

PUSH Buffalo also leads policy advocacy, which has provided the insights necessary for New York State to create needed policies and programs: PUSH's Green Development Zone principles have been codified in New York State's Sustainable Neighborhoods Program; their planning conference helped lead to Green Jobs - Green New York (GJGNY); and, their campaigns have helped the state to develop new funding sources. All of these initiatives benefit cities beyond Buffalo as well, amplifying PUSH's impact via the state government (Hart & Magavern, 2017; Push Buffalo, 2019).

5.3.2 Developing concrete anti-displacement measures that consider housing and economic conditions

Resilience investments have the potential to intensify existing displacement pressures and create new ones. Several anti-displacement tools are available to both governments and local groups.

One strategy is to create community land trusts (CLTs) that can provide a source of affordable housing for residents facing climate displacement. **Edgemere** is implementing a CLT as part of the Resilience Edgemere Community Plan (City of New York Department of Housing Preservation and Development, 2017) and **PUSH Buffalo** landbanks properties they are not yet able to develop through the Buffalo Neighborhood Stabilization Corporation (A. Kim, 2021). Zoning policy is another impactful lever. For example, **UPROSE** has advocated for maintaining Sunset Park's industrial zoning because rezoning the area risks displacing current residents, as has happened in other NYC neighborhoods (E. Yeampierre, personal communication, February 17, 2023).

WE ACT is also working on addressing cost-of-living pressures, such as campaigning to lower utility rates, make energy efficiency measures more accessible, and advocating for publicly owned and generated power. By reducing energy costs, residents are less likely to be displaced because of utility debt or the increased expenses associated with climate change, like air conditioning (S. Jessel, personal communication, August 23, 2022).

Table 5: *Community-Based Equitable Climate-Related Projects and Plans* is based on a review of online content for each of the five non-profit organizations listed in the table. Additional information was collected from the NYC based organizations, using semi-structured interviews with representatives from the following organizations: WeAct for Environmental Justice, UpRose, El Puente for Peace and Justice, and the New York City Environmental Justice Alliance.

Table 5: Community-Based Equitable Climate-Related Projects and Plans

EJ Organization & Representatives	Equitable Climate-Related Projects & Plans
El Puente *South Williamsburg, Brooklyn*	■ Our Air / Nuestro Aire 5-point action platform ■ Organize a Community Resiliency & Public Health Emergency Taskforce ■ Mitigate impacts of BQE infrastructure on local community ■ Improve greenspaces for local residents like LaGuardia Park ■ Opportunities for green jobs and training programs ■ Participating in NY Renews, Last Mile Coalition, Climate Works for All, Forest for All New York City, NYC-CAPS (Communities Activating Open Spaces), and No NBK Pipeline Coalition
NYC-EJA Citywide membership	■ NYC Climate Justice Agenda 2020 ■ Grassroots Action for Green Infrastructure Equity (GAGE) ■ South Bronx Community Resiliency Agenda with The Point CDC

EJ Organization & Representatives	Equitable Climate-Related Projects & Plans
	■ Members of PEAK Coalition, NY Renews, Renewable Rikers, Waterfront Justice Project, and Climate Works for All ■ An Equitable Recovery: Creating 100,000 Climate Jobs for Frontline Communities of Color Report 2020 ■ PEAK agreement (2020) with New York Power Authority (NYPA) to study the replacement of existing peaker plants with battery storage, leading to subsequent NYPA RFP to begin the replacement process (2022) ■ Helped pass Local Law 84 and LL85 related to extreme heat (July 2020)
UPROSE Sunset Park, Brooklyn	■ Green Resilient Industrial District Plan (GRID, 2019) ■ NYC EDC partnership for community investments related to Offshore Wind Assembly & Maintenance facility ■ Local Law 97 job training for building retrofits ■ Community Learning Circles ■ Climate & Community Health Vulnerability Assessment survey ■ G.R.A.S.P app on how to prepare for extreme weather ■ Climate Justice Youth Summit and Climate Justice Center
WE ACT Northern Manhattan	■ Extreme Heat Policy Agenda (2022) ■ Too Hot to Handle: The Reality of Extreme Heat in New York & How to Prepare Frontline Communities webinar ■ 2021 Cooling Center Report ■ Helped pass Gas Free NYC law, New York State's All-Electric Building Act (S.6843A/A.8431), the Build Public Renewables Act, and Cumulative Impacts Law (S.8830/A.2103C) ■ Solar workers cooperative ■ Advocacy/support for distribution of 74,000 air conditioning units citywide, with 22,000 of those units distributed to NYCHA residents during COVID relief ■ Climate Ready Uptown Plan (CRUP) pamphlet ■ Climate Justice Working Group
PUSH Buffalo Buffalo, NY	■ Community planning congresses shaped Buffalo's Green Development Zone (PPG, 2017) ■ Green Development Zone principles codified in New York State's Sustainable Neighborhoods Program ■ Community-based renewable energy projects ■ Green Development Zone hires local from PUSH's workforce development initiatives ■ Buffalo Neighborhood Stabilization Corporation landbank manages vacant properties to prevent displacement

6 Conclusion and Opportunities for Future Research

6.1 Conclusion

The City's climate-related equity work since 2019 has become more explicitly focused on redressing environmental injustice and racial disparities. This includes the adoption of various laws and policies, internal institutional reforms, and incorporation of equity into risk assessments and resilience planning. There is, however, limited understanding of climate change impacts and adaptation needs at the community or neighborhood level and limited systematic data exists on city-sponsored adaptation projects and resilience investments. Going forward, the City's climate-related equity work would benefit from more comprehensive data on disaggregated climate risks at the local level and tracking of city-sponsored climate adaptation projects and resilience investments across communities. Climate adaptation and resilience planning should also consider the ways that climate change challenges that NYC faces are inextricably linked to the bioregion's early history, and how climate risks for the most socially vulnerable populations are linked to both past and present land use decisions and their underlying inequities. Understanding the impacts of this history is vital for formulating just and effective policies and strategies to mitigate and adapt to climate change.

Additionally, there are ongoing community-led climate adaptation and resilience initiatives that provide examples of how NYC can more equitably and justly incorporate local needs and solutions into climate adaptation strategies. These community-led efforts also reflect the desire for intersectional climate responses to multiple environmental and social vulnerabilities such as the need for affordable, safe housing, green jobs, and neighborhood stability. Without the creation and implementation of climate policies and practices that promote racially equitable procedures and outcomes, the City will risk perpetuating inequities in new forms. For example, climate displacement is an important dimension of social vulnerability to climate change and should be measured by the City. The City's ability to measure the risks of climate displacement at an appropriate scale, such as at the neighborhood level, could help determine whether and how new climate-resilient infrastructure or infrastructure investments might risk displacement. Without anti-displacement strategies in place, resilience-promoting investments can have inequitable outcomes. These strategies most often require prioritizing community-driven climate resilience approaches that mitigate the risk of displacement.

6.2 Opportunities for Future Research and Knowledge Gaps

There are existing gaps in the state of knowledge related to the key themes covered in this chapter that are important to note for future research, broadly, as well as for consideration by the next NPCC panel. First, there is a dearth of comprehensive data related to the City's climate-related equity work that would benefit from tracking. This tracking could include equity metrics that help elucidate the relationship between vulnerability indicators and investments over time. There is also a need for more granular, neighborhood-level assessments of climate change impacts and adaptation needs along with the tracking of the performance of climate adaptation projects and investments. This type of systematic data on city-sponsored climate adaptation projects and other related climate investments, as well as more comprehensive tracking of progress on climate adaptation and disaggregated climate risk data, will help improve equity outcomes across multiple dimensions (i.e. contextual, distributive, procedural).

Climate gentrification is a dynamic process that varies across contexts and hazards. There are myriad measures and indices of climate gentrification that emphasize different driving forces and use a variety of data sources. The empirical research related to climate gentrification processes is nascent and evolving. As new methods and data sources are developed, there will necessarily be refinements in our approaches and understanding of these complex systems. These methods will also benefit from more longitudinal and evaluative research that can better characterize, on a more granular level, climate gentrification processes in varying contexts. While this chapter puts forth the Climate, Displacement, and Socio-Vulnerability (CDSV) score for multiple climate hazards (coastal and fluvial flooding, heatwaves, hurricanes, and winter weather) in NYC, this approach may also be taken up in the next NPCC report to explore additional hazards, different socio-vulnerability data, and the use of machine learning tools to better capture potential linkages between climate, displacement and socio-vulnerability indicators. It will also be important to consider how at-risk communities and the City can access these tools and apply them to help prepare for and mitigate the impacts of climate gentrification processes. Finally, longitudinal, qualitative assessments of community-based, justice-centered, climate resiliency planning and implementation can be used to inform NYC's ongoing climate adaptation practices and investments. In particular, leading environmental and climate justice organizations in NYC can offer important insights and best practices for future progress.

7 Traceable Accounts

Key Message 1	**The City's climate-related equity work since 2019 has become more explicitly focused on redressing environmental injustice and racial disparities. Over the past five years, the City has embarked on four interrelated sets of actions to foster and advance equity in its approach to climate adaptation: (1) adoption of multiple laws and programs to address equity issues related to climate change impacts; (2) internal institutional reforms in the provision of city services; (3) development of indicators and metrics and digital, interactive, and mapping platforms that are publicly accessible to track and monitor city agencies' progress; and, (4) incorporating equity into ongoing climate risk assessments and in sustainability and resilience planning.**
Description of Evidence	These findings are supported by a multifaceted assessment of the City's progress on climate-related equity work. (1) Over the past decade, the City has adopted multiple laws and subsequent programmatic initiatives designed to incorporate environmental justice and equity into citywide planning and decision-making processes. For instance, LLs 60 and 64 from 2017(Local Law 60, 2017; Local Law 64, 2017) established the EJAB and EJ IWG which are responsible for the EJNYC report, EJNYC Web-based Portal and Mapping Tool and the EJNYC plan; LL 78 of 2021 (Local Law 78, 2021, p. 78) resulted in the creation of the Equitable Development Data Explorer and a Displacement Risk Map along with a requirement of Racial Equity Report for certain land use actions; and LL 122 of 2021 (Local Law 122, 2021, p. 122) resulted in the creation of the AdaptNYC program, a citywide climate adaptation plan, and the Climate Strong Communities program. (2) The City has increased efforts to advance racial equity and social justice within city agencies. It joined the Government Alliance for Racial Equity (GARE) network and employed GARE's Racial Equity Assessment tools to guide the development of racial equity policy and foster internal changes (Government Alliance on Race and Equity, 2023). Through Executive Order 45 (2019), the City created the EquityNYC program, designed to assess equity outcomes in the provision of city services and equity practices across city agencies (Executive Order 45, 2019). Integration of racial equity is observed in operational and planning efforts in other city agencies. Examples include the Department of Health and Mental Hygiene's Race to Justice Action Kit, NYC Commission of Human Rights' Anti-Black Racism Report, and the Department of City Planning's Comprehensive Waterfront Plan (City of New York Commission on Human Rights, 2019; City of New York Department of City Planning, 2021b; City of New York Department of Health and Mental Hygiene, 2023). (3) The City has multiple initiatives to identify indicators and metrics to track progress on equity and develop digital and interactive mapping platforms to foster transparency, and accountability. NYC Opportunity is leading the effort to identify and evaluate indicators and metrics on social and racial equity with initiatives include the social and equity indicators, poverty measures, and workforce metrics; these can be visualized on publicly accessible online platforms (City of New York Mayor's Office for Economic Opportunity, 2023b; *Poverty Measure - NYC Opportunity*, n.d.; *Social Indicators Report - NYC Opportunity*, n.d.). With goals to communicate progress and promote community- and neighborhood-level planning, other city agencies have also developed mapping tools for visualizing data on population, land use and zoning, and environmental risks and vulnerability. Data sources for many of these tools are available for download on the NYC Open Data website (City of New York, 2022). In addition, more citywide policy and planning documents (e.g., NYC Hazard Mitigation Plan, NYC Comprehensive Waterfront Plan, AdaptNYC program) are made available online in digital and interactive formats designed to be changed and updated over time, functioning as "living" documents rather than static ones (City of New York Department of City Planning, 2021b; City of New York Mayor's Office of Climate & Environmental Justice, 2022a; *Plan for Hazards - Hazard Mitigation - NYCEM*, n.d.). (4) The City continues to incorporate equity into ongoing climate risk assessments and sustainability and resilience planning. MOCEJ is currently sponsoring the Climate Vulnerability, Impact, and Adaptation Analysis (VIA) study to develop a comprehensive assessment of future potential climatic conditions and associated impacts in NYC (McPhearson et al., 2024). The VIA research has the potential to advance equity by providing key information and tracking tools on most at-risk populations and can be used to inform the development of forward-looking adaptation strategies that prioritize vulnerable populations and EJ areas. Environmental justice and health equity are core components of the City's latest sustainability

	and resilience vision, PlaNYC: Getting Sustainability Done (City of New York Office of the Mayor, 2023b). The plan contains multiple initiatives designed to increase resiliency and access to green and climate investments for vulnerable groups. Examples include the Climate Strong Communities program, FloodHelpNY and HomeFix programs, electrification and efficiency upgrades for NYCHA housing, and workforce development and training for green and circular economy sectors (City of New York Office of the Mayor, 2023b).
New Information and Remaining Uncertainties	While there is strong evidence that NYC has made progress in terms of integrating environmental justice and racial equity into its climate work, there are remaining uncertainties about the outcomes of climate-related equity efforts. Considering that many of these initiatives have been recently proposed or are only now underway, it remains difficult to determine whether locally relevant adaptation needs (as well as other quality-of-life needs) are being addressed. Other uncertainties are about the effectiveness of climate investments in addressing the root causes of environmental and social inequities and building adaptive capacity in underserved and marginalized communities. The data used to assess the City's progress was largely based on a review of City-initiated reporting documents and a sampling of expert interviews. There is limited peer-reviewed literature and no systemic review of the treatment of equity across NYC agencies. Thus, the evidence is limited by the number of respondents interviewed and the author's expert review of existing primary source documents from the City's public records.
Assessment of Confidence based on the Evidence	Given the evidence base, there is high confidence that NYC's climate-related equity work has advanced efforts to address environmental injustice and racial disparities.
Key Message 2	**The City's climate-related equity work would benefit from more comprehensive data on disaggregated climate risks at the local level and tracking of city-sponsored climate adaptation projects and resilience investments. There are limited understanding of climate change impacts and adaptation needs at the community or neighborhood level and limited systematic data exists on city-sponsored adaptation projects and resilience investments. More disaggregated climate risk data and systematic tracking of city-sponsored climate investments are needed.**
Description of Evidence	These findings are supported by the author's expert review and assessment of the City's efforts to characterize climate risks and adaptation needs at the community and neighborhood levels and to communicate progress on climate adaptation and resilience projects. While there are 59 community districts and numerous neighborhoods in New York, current evidence suggests that the City has only a few city-sponsored place-based or community-based adaptation plans. Examples include the Resilient Neighborhoods Studies, the Lower Coastal Manhattan Coastal Resilience Project, the Cool Neighborhoods NYC program, and the Resilience Edgemere Community Plan (City of New York Department of Housing Preservation and Development, 2017; City of New York Mayor's Office of Resiliency, 2017; *Lower Manhattan Coastal Resiliency (LMCR)*, n.d.; *Resilient Neighborhoods*, n.d.). While City has spent 73 percent of the $15 billion of federal appropriated rebuilding and recovery grants (as of June 2022), evidence suggests that current efforts to track and communicate climate adaptation projects and resilience investments do not provide a complete picture of the City's spending progress and the status of completed and planned projects (Yeung & Levers, 2022). For example, the Sandy Funding Tracker lacks detailed information about the status or anticipated completion dates of federally funded adaptation and resilience projects and City's capital contribution to these projects (City of New York Office of Emergency Management, 2023b). On the other hand, while the NYC Mitigation Actions Map conveys the status and location of the City's capital investments in hazard mitigation projects, without comprehensive community-based adaptation plans and strategies for each of the 59 community districts and/or neighborhoods, it remains difficult to determine whether local adaptation needs are identified and/or addressed (*CRA Dashboard – NYC Hazard Mitigation*, n.d.).
New Information and Remaining Uncertainties	With regard to characterizing climate risks and adaptation needs for communities and neighborhoods, the City has recently developed multiple initiatives designed to address this issue including the AdaptNYC program, the Climate Strong Communities program, and the Climate Vulnerability, Impact, and Adaptation Analysis (VIA) study (City of New York Mayor's Office of Climate & Environmental Justice, 2022a, 2022b; McPhearson et al., 2024). Uncertainties are related to engagement and coordination with local stakeholders, integration of local knowledge, and how climate interventions and investments reflect local

	planning goals, visions, and desires. There is currently little or no independent peer-reviewed literature assessing this topic comprehensively across the City. With regard to the systematic tracking of the City's adaptation projects and resilience investments, the New York City Office of the Comptroller has recommended that the City develop a Capital Project Tracker which provides detailed information about neighborhood-level projects (Yeung & Levers, 2022). The City, in response, implemented the NYC Capital Projects Dashboard in 2023 (City of New York Mayor's Office of Operations, 2024). Furthermore, the City is currently implementing an initiative called climate budgeting, which can potentially enable transparent tracking of capital funding for sustainability and resiliency initiatives pursued by city agencies (City of New York Office of the Mayor, 2023b). Given that the City is releasing its first Climate Budget in April 2024, it remains to be seen how exactly this process will evolve. Lastly, the City is counting on new federal and state funding streams to implement current unfunded planned and proposed projects (City of New York Office of the Mayor, 2023b). There are uncertainties regarding whether the City will be able to acquire sufficient state and federal funding necessary to complete these projects as well as how it plans to allocate and track the spending of the funds.
Assessment of Confidence based on the Evidence	Given the evidence base, and author's expert review of the City's reporting to date, there is high confidence that the City's climate-related equity work would benefit from more comprehensive data on disaggregated climate risks and adaptation needs at the local level and from systematic tracking of city-sponsored climate adaptation projects and resilience investments.
Key Message 3	**Some of the city's most vulnerable communities have evolved their approaches to combat a variety of environmental, climate, and social stressors. The organizations profiled in NPCC3's equity section report that they are implementing dynamic approaches to address the various risks they face while providing multiple benefits to their communities. These benefits include expanding access to solar energy and providing upgrades for cooling residences experiencing high heat and air pollution exposure.**
Description of Evidence	Three of the four organizations profiled in the equity chapter of the last NPCC3 report (Foster et al., 2019) were interviewed for updates to their climate adaptation initiatives. The author relied on public documentation online for the organization not interviewed. These organizations are located in areas mapped as most socially vulnerable to climate risks, as indicated by the SOVI index and similar indices. We followed up with these same organizations to determine their progress and evolution in addressing the multiple and intersecting climate, social, and economic stressors they face. Evidence was obtained directly from semi-structured interviews with implementing organizations and documentation, such as reports, retrieved from organizational websites.
New Information and Remaining Uncertainties	The assessment of progress to date and implementation was based on primary data sourced from semi-structured interviews with organizations and a review of publicly accessible reports. There is no peer-reviewed literature that has assessed this implementation process. Also, one organization was not reached directly, thus the full extent of their climate adaptation work may not be fully reflected in this report.
Assessment of Confidence based on the Evidence	There is a High confidence level that the reported updates and approaches to climate adaptation by NYC based environmental justice organizations have produced multiple benefits for respective environmental justice communities based on the author's review of primary source data and organizational reports.
Key Message 4	**The climate change challenges that NYC faces are inextricably linked to the bioregion's early history, including slavery and land dispossession. Understanding the impacts of this history is vital for formulating effective policies and strategies to mitigate and adapt to climate change. An appreciation of the historical legacy of climate impacts on the region, and on certain communities, also necessitates a commitment to reparations and restorative justice. By recognizing Indigenous knowledge, seeking restorative justice, and reconceptualizing our relationship to land, the City can forge a future that respects the environment, promotes social justice, and ensures the well-being of all communities.**
Description of Evidence	Cronon (Cronon, 2003) firmly established the relationship between colonial impacts on the ecology of New England and opened the examination of colonialism and environmental history. Wolfe (Wolfe, 2006) initiated the working historical theory of "settler colonialism" and Kauanui (Kauanui, 2016) discusses the ramifying impacts of this framework for interdisciplinary and Indigenous scholarship. Lipman (Lipman,

	2016) (2016) like Cronon examines the ways in which Coast Algonquian communities tended the "saltwater" estuaries that also became a colonial contact zone in the Long Island sound region. The Public History Project (PHP) is researching the interlinkage between Dutch and English trade and settler colonists engaged in dispossession, enslavement, massive extraction, and Atlantic World trade. This short historical section derives from this PHP research project. Perhaps most significant for the NPCC, the IPCC has regularly cited Indigenous Knowledge and Traditional Ecological and Environmental Knowledge as important knowledge that need to be enlisted in addressing climate crisis.
New Information and Remaining Uncertainties	The study of landscape ecology, Indigenous studies, enslavement studies, extractivism, and trade is a growing field of study and archives building. The evidence of each of these study areas has been well established, but the intersections of once-siloed areas of specialization are currently being explored by scholars in a variety of academic fields, including anti- and decolonial studies, Indigenous Studies, and African American/diasporic studies.
Assessment of Confidence based on the Evidence	Given the evidence from the historical record, peer-reviewed literature across multiple disciplines (i.e. decolonial studies, indigenous studies, anthropology, history, etc.) and the expert review of the author, there is high confidence that a systemic understanding of the history of NYC's development dating from pre-colonial records to the present, are relevant to the understanding of climate injustices.
Key Message 5	**Climate risks for the most socially vulnerable populations are linked to both past and present land use decisions and patterns and their underlying inequities. Although the relationships between historical land use and climate risk are complex and context-dependent, they often have similar underlying mechanisms such as past discriminatory land use and siting decisions, redlining and disinvestment, and lower land costs in hazard-prone areas. Many of these land use issues—past and present—reinforce one another and create future risks and vulnerabilities. Without intentional, anti-racist work toward climate mitigation, adaptation, and resilience, NYC will risk perpetuating these inequities in new forms.**
Description of Evidence	These findings are based on a growing body of literature that connects past and present land use to climate risks and social vulnerability today, with studies having the greatest focus on redlining (Hoffman et al., 2020; Katz, 2021; Wilson, 2020). Other evidence comes from research on hazardous and industrial land use (Maantay, 2002; Marlow et al., 2022; Mizutani, 2018), housing and investment decisions (Buchanan et al., 2020; Lee & Jung, 2014), aspects of geography—such as elevation and waterfronts (Collins et al., 2018; Keenan et al., 2018; Villareal, 2013) — and transportation planning and infrastructure (Faber, 2015; Hoffman et al., 2020). Academic studies also provide evidence on how land use issues contribute to future vulnerabilities, such as through disparities in buyouts (Elliott et al., 2020; Mach et al., 2019; Shi et al., 2022) and the inequitable distribution of investments in resilience and adaptation (Gould & Lewis, 2018; Hummel et al., 2021; Shokry et al., 2020). Research grounded in specific cities and communities, as well as news reports, demonstrate how local contexts and histories can moderate these general patterns (Campo-Flores & Kusisto, 2019; Lee & Jung, 2014; Peacock et al., 2014).
New Information and Remaining Uncertainties	There are relatively few studies that connect historical land use to climate risk in NYC specifically. Although studies from other locations suggest patterns that may appear in New York, contextual similarities and differences remain an important factor in determining how to interpret this evidence.
Assessment of Confidence based on the Evidence	Given the evidence base, there is high confidence that historical and present land use contributes to climate risk for socially vulnerable groups, particularly through the legacy of redlining. There is also high confidence that land use and adaptation decisions today will continue to affect this landscape.

Key Message 6	**Climate displacement is an important dimension of social vulnerability to climate change and should be measured by the City. The City's ability to measure the risks of climate displacement at an appropriate scale, such as at the neighborhood level, could help determine whether and how new climate-resilient infrastructure or infrastructure investments might risk displacement and identify ways to mitigate that risk. A combined climate displacement and social vulnerability (CDSV) score is proposed to integrate socio-economic, climate risk, and evictions and housing data to better measure the risks of climate displacement at the census-tract level.**
Description of Evidence	There is a developing literature on climate displacement or gentrification that has identified different "pathways" by which climate risks and impacts can operate to impact geographies and property markets (Keenan et al., 2018). The literature identifies three types of climate displacement or gentrification: the superior investment pathway, the cost-burden pathway, and the resilience investment pathway. Increasingly, studies assess the resilience investment pathway (K. Best & Jouzi, 2022) and further complicate the other pathways by recognizing that climate displacement is a complicated and dynamic process (Black et al., 2013). There are now a number of case studies documenting these dynamics in cities such as Miami (Keenan et al., 2018; Li & Grant, 2022), New Orleans (Aune et al., 2020), Seattle (de Koning & Filatova, 2020; Rice et al., 2019), and Philadelphia (Shokry et al., 2022). Moreover, a number of researchers have created climate displacement and gentrification indices based on a mix of demographics, physical characteristics, climate risk and other factors (Aune et al., 2020; K. B. Best et al., 2023; Melix et al., 2023; Tedesco et al., 2022). Although the literature has demonstrated that there is context-specific climate displacement (out-migration of households) that is attributable to various social, environmental, and land use patterns, it is not clear whether gentrification (in-migration of high-income households) is a separate or intertwined phenomenon (S. K. Kim & Park, 2023). Existing research is illuminating but more research is required to understand larger-scale patterns of migration and the exact relationship between climate change and gentrification. Moreover, there has been no study of climate displacement or gentrification in NYC.
New Information and Remaining Uncertainties	NYC There are several metrics that are being or have been developed to account for socio-vulnerability and climate hazards. Nevertheless, only a few studies focus on displacement and, very importantly, on the compounding effects of the hazards. In this regard, the CDSV score for NYC referenced here (Tedesco et al., 2024) provides an opportunity and specific metric the City to assess the combined effects of climate, socio-vulnerability, and displacement and identify areas where early intervention might be necessary. Adopting or adapting the CDSV score referenced here is promising based on the reported results. However, limitations and uncertainties remain in the methodology. For example, the CDSV for NYC adopts a linear combination of the scores from the multiple climate hazards, which implicitly doesn't account for non-linear effects (e.g., feedbacks among hazards) and doesn't resolve potential double-counting issues. Moreover, information on the margins of error (MOE) is not always available and should be accounted for in the future as part of the assessment of the outputs.
Assessment of Confidence based on the Evidence	Given the evidence base, there is very high confidence that climate displacement exists in a range of U.S. cities as a result of the interaction between climate risks, social vulnerability, and land-use patterns and dynamics. There is high confidence that climate is one driver of displacement risk, and that migration is responsive to climate risk. There is also high confidence that the CDSV score referenced here can be adopted or adapted by the City to better understand the compounding effects of specific climate hazards, social vulnerability, and displacement.

Key Message 7	**Without anti-displacement strategies in place, resilience-promoting investments can have inequitable outcomes. These strategies require several key approaches: (1) incorporating contextual equity and understanding the history of places down to the neighborhood level; (2) taking a holistic approach to reducing racialized vulnerability to climate shocks, including inseparable issues like housing and transit access; and, (3) recognizing that the cost burdens of climate adaptation (e.g., higher energy costs, insurance premiums, relocation) affect people differently—particularly when considered in light of homeownership and wealth gaps—and can result in increased displacement risks.**
Description of Evidence	Researchers have found significant links between climate risks, adaptation investments, housing, socio-economic inequalities, and residential migration and displacement (Rice et al., 2020; Shokry et al., 2020, 2022). Taken as a whole, the studies conducted on climate displacement and gentrification are now able to identify with more specificity how climate impacts and adaptative measures may contribute to changes in community characteristics and potential displacement of vulnerable residents in specific geographies (K. Best & Jouzi, 2022). These studies suggest that adaptative measures and resilience-promoting investments should account for the relationships identified in those studies to reduce the risk of displacing the most vulnerable and marginalized communities.
New Information and Remaining Uncertainties	The relationships between displacement and resilience-promoting investments, energy and other cost burdens, are still being investigated. There are an increasing number of studies investigating these relationships in specific places and geographies. No such study has been conducted in or for NYC.
Assessment of Confidence based on the Evidence	There is very high confidence that resilience-promoting investments can increase the risk of displacement in socially and economically vulnerable and marginalized communities. There is high confidence that providing affordable housing and reducing the costs burdens of climate adaptation can benefit these communities.

Key Message 8	**Key to achieving equitable climate adaptation is to prioritize community-driven climate resilience approaches. As an example of successful approaches, community-based organizations featured in NPCC3 have implemented climate adaptation initiatives that were attentive to the intersecting nature of climate risks and other health vulnerabilities, including the COVID-19 pandemic. These initiatives include climate mitigation strategies and provide multiple benefits including equitable access to renewable energy, affordable and efficient housing, and economic development strategies that promote equitable green, adaptation economies.**
Description of Evidence	There is growing and significant literature on community-driven climate resilience planning that finds the results of that planning are perceived to be, or are, fairer and more procedurally just than top-down, government or private sector led initiatives (Binder & Greer, 2016; Shokry et al., 2020). The findings of these studies were echoed in our interviews conducted with climate resiliency experts, city officials, and community-based organizations via semi-structured interviews as well as online website content review. In addition, previous case studies of NYC communities also document how community-driven climate planning seeks to address the multiple and intersecting risks that the most vulnerable and at-risk communities experience (Foster et al., 2019). There is also evidence in the peer reviewed literature that features the work of some of these NYC based environmental justice organizations as innovative and reflective of intersectional, climate justice approaches, including: Sze & Yeampierre (Sze & Yeampierre, 2017), Bautista, Osorio & Dwyer (Bautista, Osorio, et al., 2015), Nguyen & Leichenko (Nguyen & Leichenko, 2022), Rudge (Rudge, 2020, 2021), Bautista, Hanhardt, Osorio, & Dwyer (Bautista, Hanhardt, et al., 2015), Shi (Shi, 2021), and Baptista, Matsuoka, & Raphael (Baptista, 2024).
New Information and Remaining Uncertainties	There is a diversity of innovative approaches to equitable and just climate adaptation and resiliency planning and practices. No one approach is broadly applicable to every NYC community. However, each organization described new approaches to addressing intersecting climate, environmental, health, displacement, and other risks even while many of the impacts of their initiatives are still in the implementation or planning phases. There are uncertainties about how some of these initiatives will be implemented and whether additional lessons will be learned from long-term adaptation strategies. Longitudinal, qualitative research is needed to more fully understand these approaches and their applicability across contexts.

Assessment of Confidence based on the Evidence	There is very high confidence that the community-driven approaches to resilience and adaptation planning reflected in the efforts of the four NYC based environmental justice organizations interviewed are perceived to be more just and contribute to procedural equity overall. There is high confidence that some of these approaches have successfully been put into practice and are viewed as leading strategies as evidenced by both primary source reporting and the peer-reviewed literature.
Key Message 9	**Best practices from around NYC and the world highlight the importance of integrated, affirmatively anti-racist, equitable, and just approaches to tackling climate risks. The three broad categories of best practices identified for more equitable and racially just climate adaptation approaches are: (1) integrative approaches to climate resilience that seek out opportunities to advance just transitions and adaptive economies; (2) community-centered planning processes that make adaptation plans more successful in the face of intersecting housing and climate displacement risks; and, (3) collaborative development of goals, programs, policies by leveraging relationships between communities, civic organizations, and state and local government offices and programs.**
Description of Evidence	The ways that different communities, including local governments, respond to climate change and how they incorporate contextual and procedural equity is a rapidly growing field of research. Much of this research revolves around case studies. This workgroup reviewed the literature but sought to identify adaptation and mitigation practices in communities facing the multiple and intersecting risks identified by some of the most vulnerable NYC communities (Foster et al., 2019). We conducted semi-structured interviews with representatives from local environmental and climate justice identified community-based groups. We examined local case studies representing the City's efforts to engage in planning that reflected integrative and community-centered planning processes. We also identified practices outside of New York that were community-driven and addressed the multiple and intersecting risks facing these communities.
New Information and Remaining Uncertainties	There are uncertainties regarding best practices for incorporating justice into a city's adaptation and mitigation policies, plans, and actions. These uncertainties exist because of the need to adapt practices successfully employed in one place to another context. As such, just approaches should seek to understand and incorporate local knowledge and context. The uncertainties that exist are therefore uncertainties with regard to the application of specific practices in specific contexts.
Assessment of Confidence based on the Evidence	There is a High confidence level that the featured best practices reflect the importance of just climate adaptation approaches to address climate risks. This assessment is based on the author's expert review of a broad cross section of peer-reviewed literature on just climate adaptation approaches that are relevant for NYC's context.

8 Sustained Assessment

Climate justice requires careful attention to the intersecting impacts of climate change, social vulnerability, legacy pollution, as well as housing, energy, and health burdens. Sustained assessments of equitable and racially just climate adaptation strategies should include mechanisms for deepening community engagement to gather more granular data about climate risks that are emerging or exacerbated over time. Increased community partnerships can also help track the implementation of climate adaptation strategies and report on their potential to address multiple, intersecting forms of climate risks. Many community-based environmental justice organizations have experience with emergency response and adaptation needs and risks. They may also have community-based plans and initiatives for equitable climate adaptation that can be leveraged with City agencies to produce multiple benefits (Maantay & Maroko, 2009; Marlow et al., 2022; Mizutani, 2018).

Sustained assessments can also build on the robust set of existing indicators and interactive data platforms for environmental justice (i.e. NYC EJ Web Portal), climate change (i.e. NYC Environmental and Health Data Portal, NYC Climate Dashboard), and housing displacement (i.e. Equitable Development Data Explorer) available in NYC. There is an opportunity to build on the CDV scoring approach developed in this assessment to track climate displacement over time in NYC. The use of multiple vulnerability indicators and mapping tools can help elucidate areas of overlapping climate risk where specific measures may be needed. The use of combined indicators of social vulnerability, housing displacement risk, and diverse climate risks requires updated, grounded data that can be reviewed by communities as well.

Future assessments can consider ways to collect and monitor the distributive, procedural, and context-related equity dimensions of climate-related investments. For example, future efforts are needed to compile a comprehensive set of climate adaptation investments across NYC, from multiple agencies and funding sources. There is also a need to monitor and evaluate the distribution and impacts of the various types of climate adaptation investments over time using an equity framework. There is an opportunity to leverage and build on NYC's Environmental Justice Web Portal and Environmental Justice Plan, to incorporate climate displacement indicators and climate adaptation investment tracking systems. These ongoing, publicly available data sources can include community-sourced climate risk data, adaptation projects, and emerging needs over time (See Mayor's Office of Climate and Environmental Justice).

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The assessment does not represent the policy position of any agencies whose staff are co-authors.

Figures List

Tables List

Equation List

Box List