Mapping the Garbage Epidemic in NYC

"The consequences of actions which desecrate
Nature are often untraceable
to those who are responsible" – Dasgupta

Introduction

This booklet takes us through the world of Trash in New York City. Starting before the implementation of NYC's Zero Waste plan, we will explore the spatial relationships of trash in our city, and investigate the successes and failures of the cities attempts to end waste in New York.

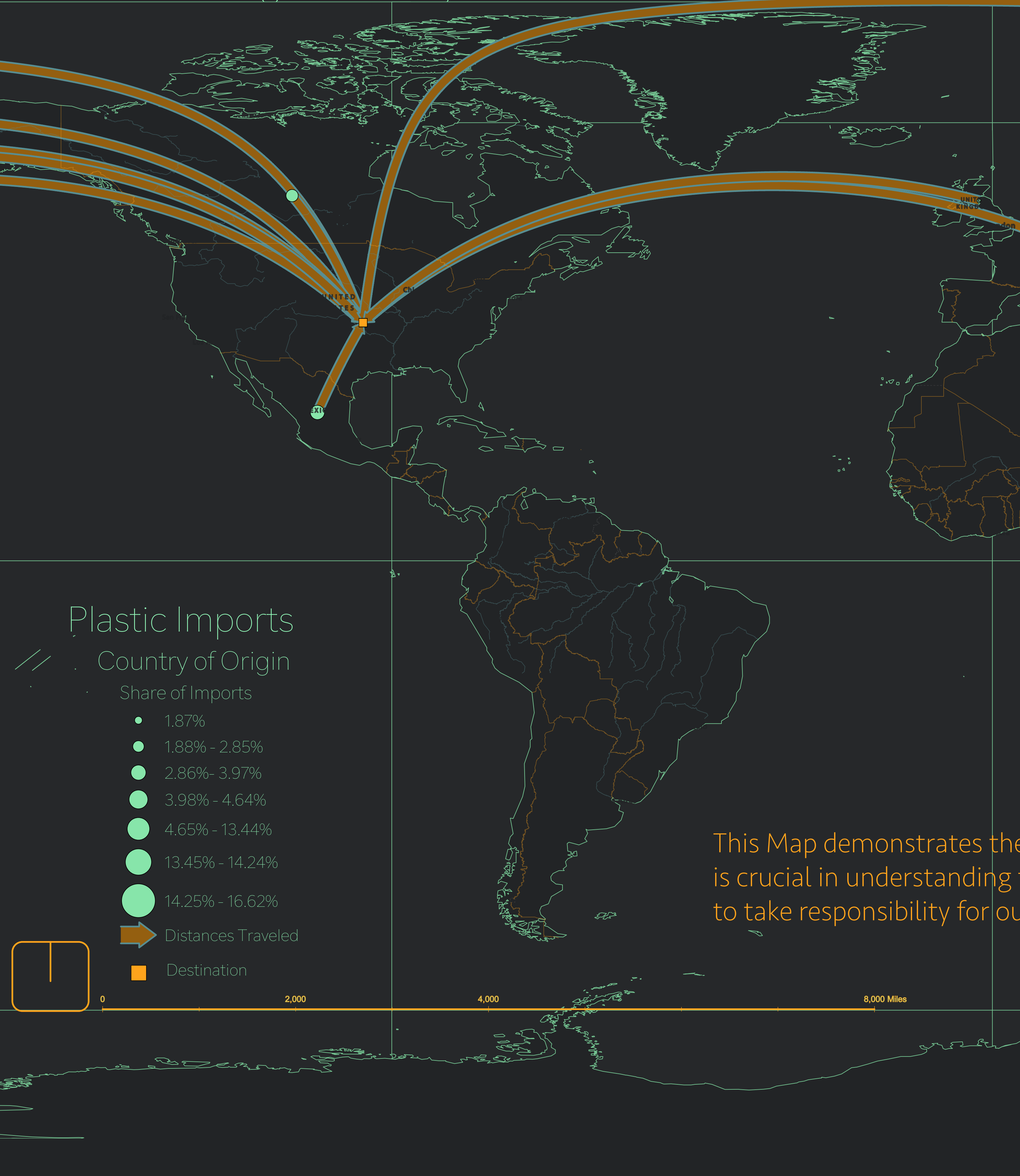
Research Question:
How effective is New York City's Zero Waste Plan, what challenges hinder its success, and what strategies can be implemented to improve it?

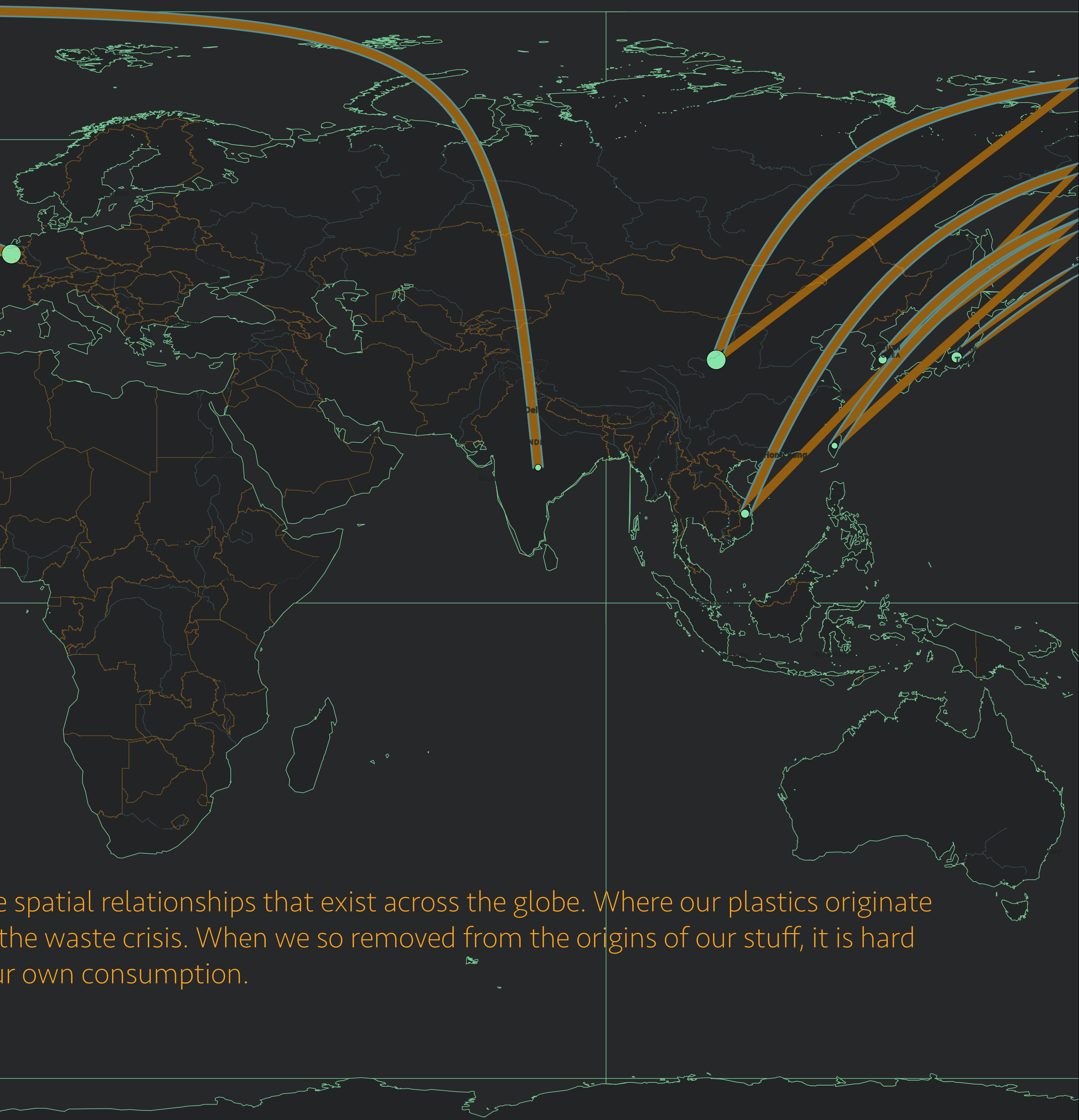
Contents:

I. Thinking about Trash

Where does our trash come from, and where does it go? It starts as something other than trash, but most things we consume end up as such. If we look back on the life of a candy bar, its components begin from all corners of the globe. The cocoa beans may originate in West Africa, the nuts may come from South America, and the preservative palm oil comes from Indonesia. The plastic wrapping may come from India, and the packaging and processing may happen in Mexico before it is distributed worldwide. What starts as a raw material eventually turns into a finished product that is then sold in the bodega down the street, where we buy it, eat it, and throw what is left of it in the garbage can on the street corner. In New York, the department of sanitation then takes over collecting it from that corner, where it is brought to a transfer station. Eventually, the candy bar remnant finds itself in a dump, maybe upstate, maybe back across the world, it is hard to know for sure. But while this final destination may be unknown, the used-up candy bar finds itself in a permanent home, surrounded by trash just like itself. What happens then? And how does the item's origin relate to the landfill that becomes its final destination?

Looking Upstream:
Understanding the life cycle of waste





e spatial relationships that exist across the globe. Where our plastics originate
the waste crisis. When we so removed from the origins of our stuff, it is hard
ur own consumption.

World Trade Organization (WTO). World Trade Statistical Review. World Trade Organization, 2023, https://www.wto.org.

II. Methods:

The methodology for this project focused on transforming New York City's waste management data into spatial information to evaluate the implementation of the Zero Waste Plan. Data sources included DSNY facility records, borough-level waste tonnage data, and community district boundary shapefiles. A significant limitation was that the waste tonnage data only covered Manhattan, the Bronx, and Staten Island, which constrained the scope of analysis. Demographic data from the U.S. Census Bureau was also incorporated to explore socioeconomic patterns influencing waste production and recycling rates. Using Python, many datasets, initially in tabular form, were cleaned by standardizing formats, removing null values, and preparing them for spatial integration.

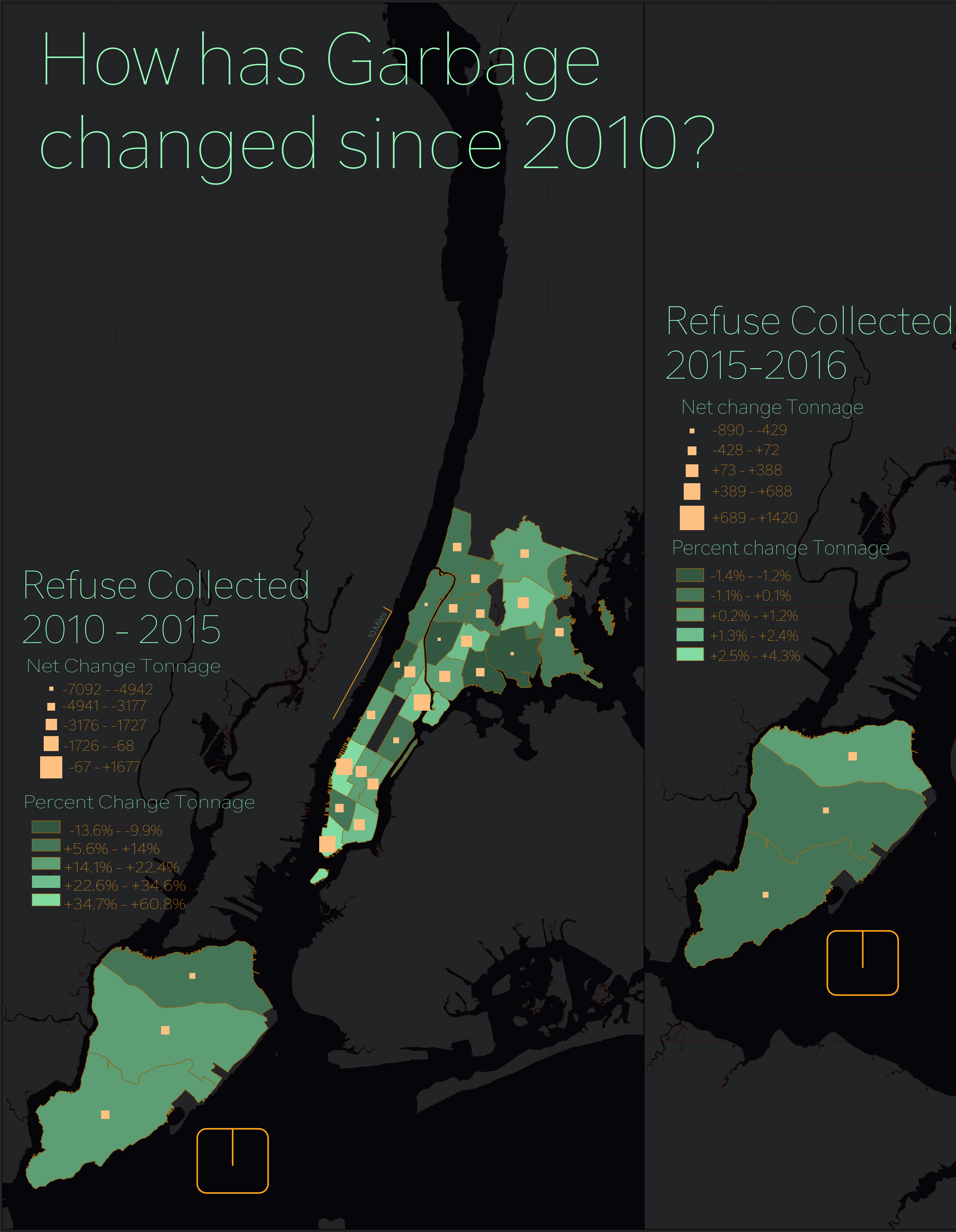
Using ArcGIS Pro, multiple spatial tools were applied to convert and analyze the data. Geocoding was used to map DSNY facilities as point features, visualizing the distribution of recycling centers, transfer stations, and disposal sites. To attribute borough-specific waste tonnage to geographic areas, a field-to-point transformation converted tonnage data into spatial points, which were then joined to community district. A buffer analysis was performed around key waste comto assess infrastructure access and visualized the movment of waste within our city, while overlays with demographic layers helped reveal spatial inequities between waste output and socioeconomic variables. Kernel Density was used to visualize wealth concentration, and overlapping variables helped build an analytical story that helps us understand what is going on in our city.

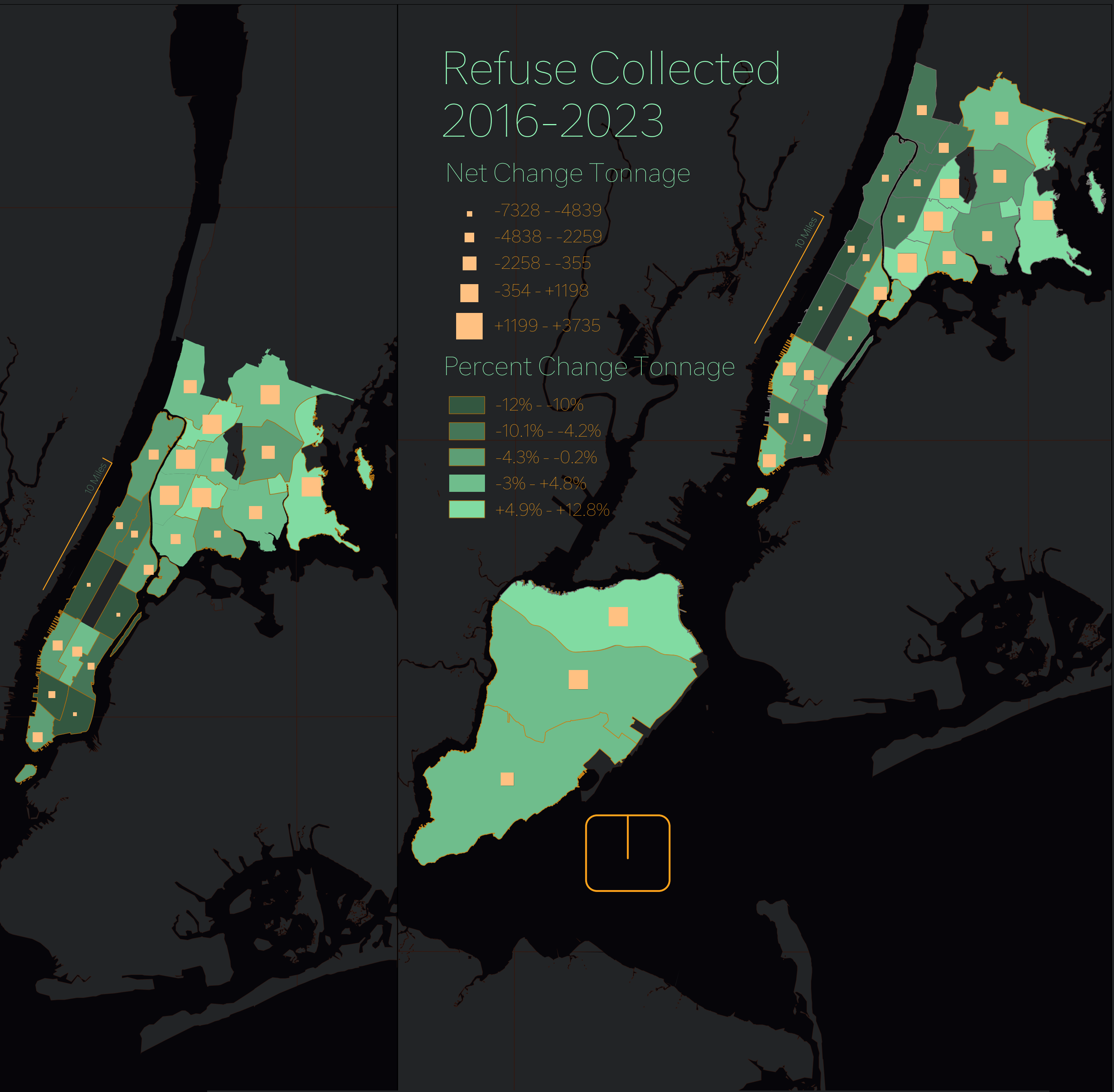
The outputs of these spatial processes resulted in a series of maps and analyses highlighting key patterns. Geocoded DSNY facilities revealed gaps in infrastructure coverage relative to high-waste districts, while the spatial joins and overlays identified clusters of high waste generation, particularly in boroughs with lower recycling rates.

By combining these tools with demographic analysis, the methodology effectively exposed spatial inequities and provided a robust framework for assessing progress toward NYC's Zero Waste goals.

Finding comprehensive data for this analysis proved challenging, particularly regarding the final destinations of waste after it leaves transfer stations. Additionally, there were significant gaps in data coverage for parts of the city, limiting the scope of spatial analysis. Notably, I was unable to locate borough-level or district-specific tonnage data for compostable materials, which prevented their inclusion in the final maps. However, I incorporated insights from the NYC Waste Composition Report to inform my analysis. While the report's PDF format posed limitations for direct spatial mapping, I worked to extract and synthesize key statistics, which provided valuable context and supported the interpretation of waste trends across the city.

How has Garbage changed since 2010?





The findings suggest that while refuse collection trends have slightly fluctuated over time, certain areas show persistent high refuse generation, indicating a need for targeted waste reduction strategies.

NYC Open Data. NYC Open Data Portal. City of New York, https://opendata.cityofnewyork.us. Accessed
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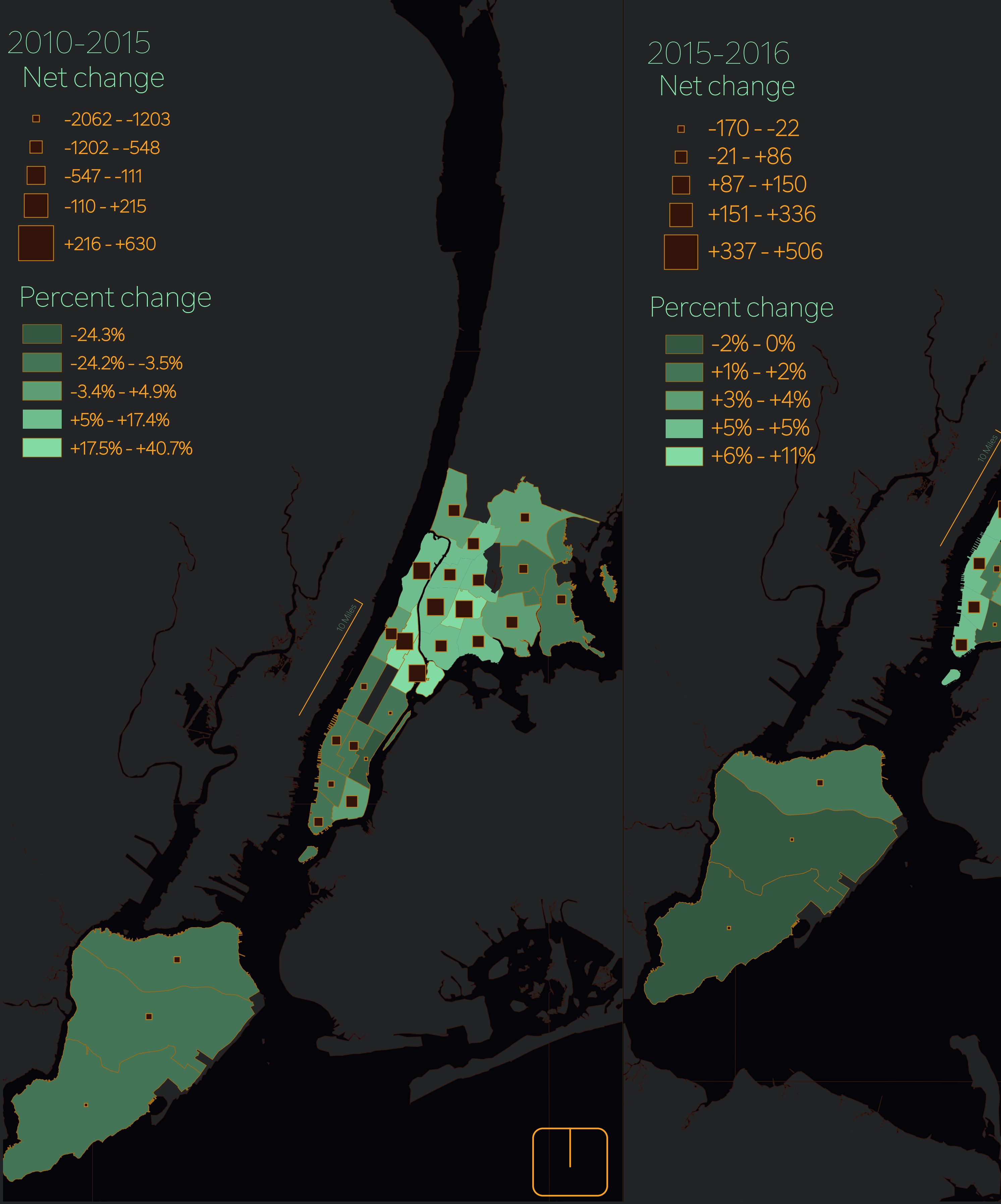
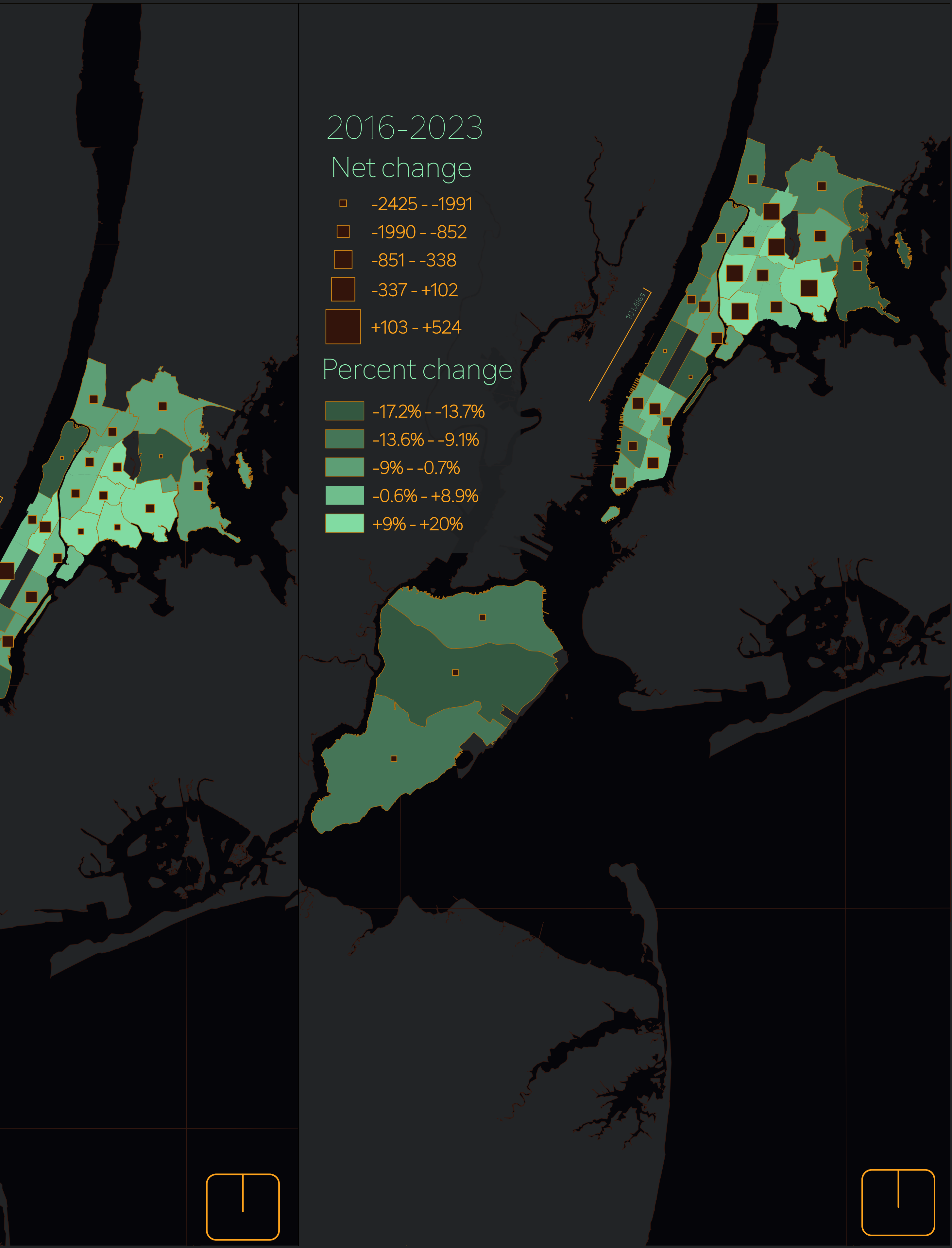
Have New Yorkers Gotten Better at Recycling Paper?





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United States Census Bureau. American Community Survey 5-Year Estimates (2015-2019). U.S. Department of Commerce, 2020, https://www.census.gov.

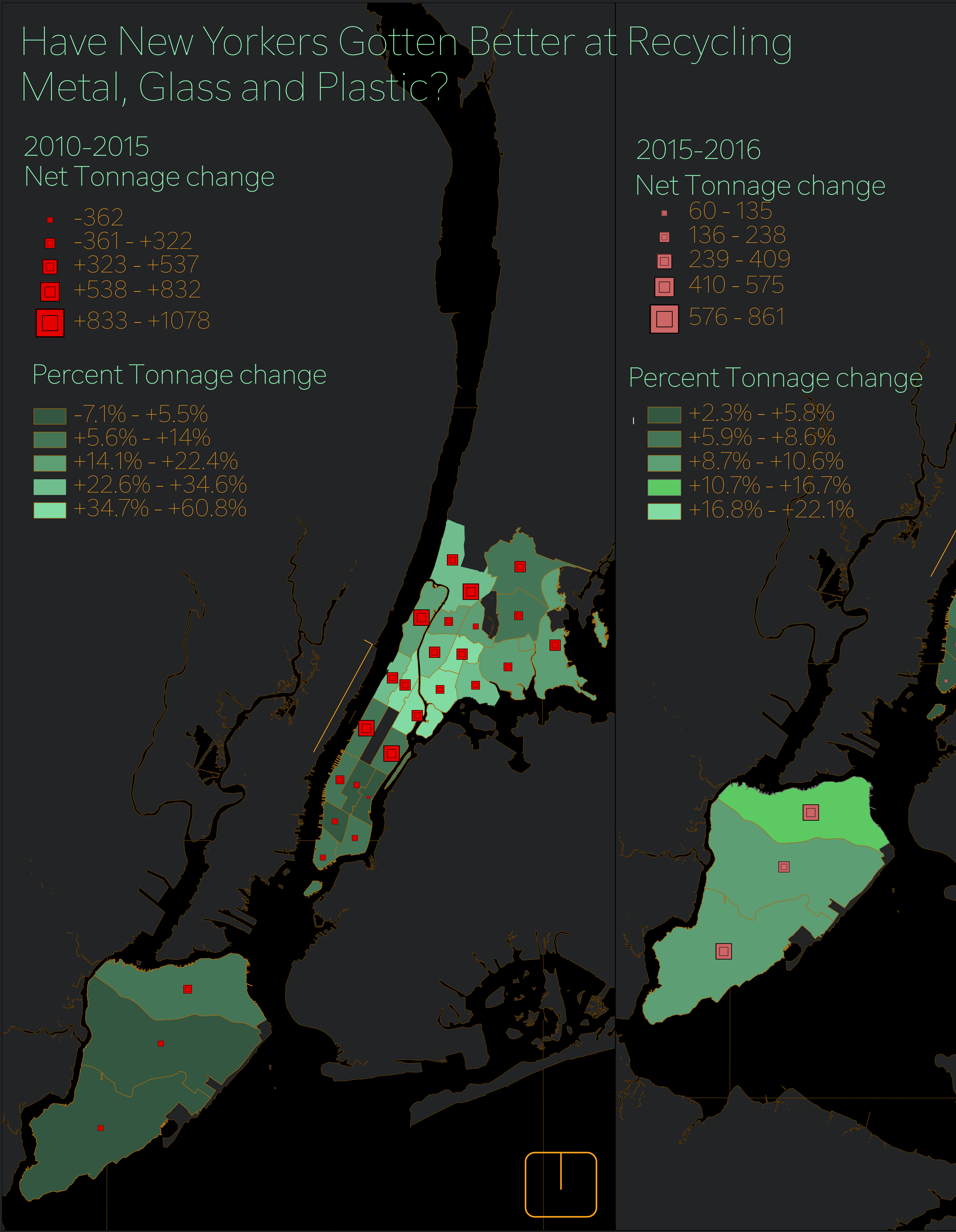
Above Figure:

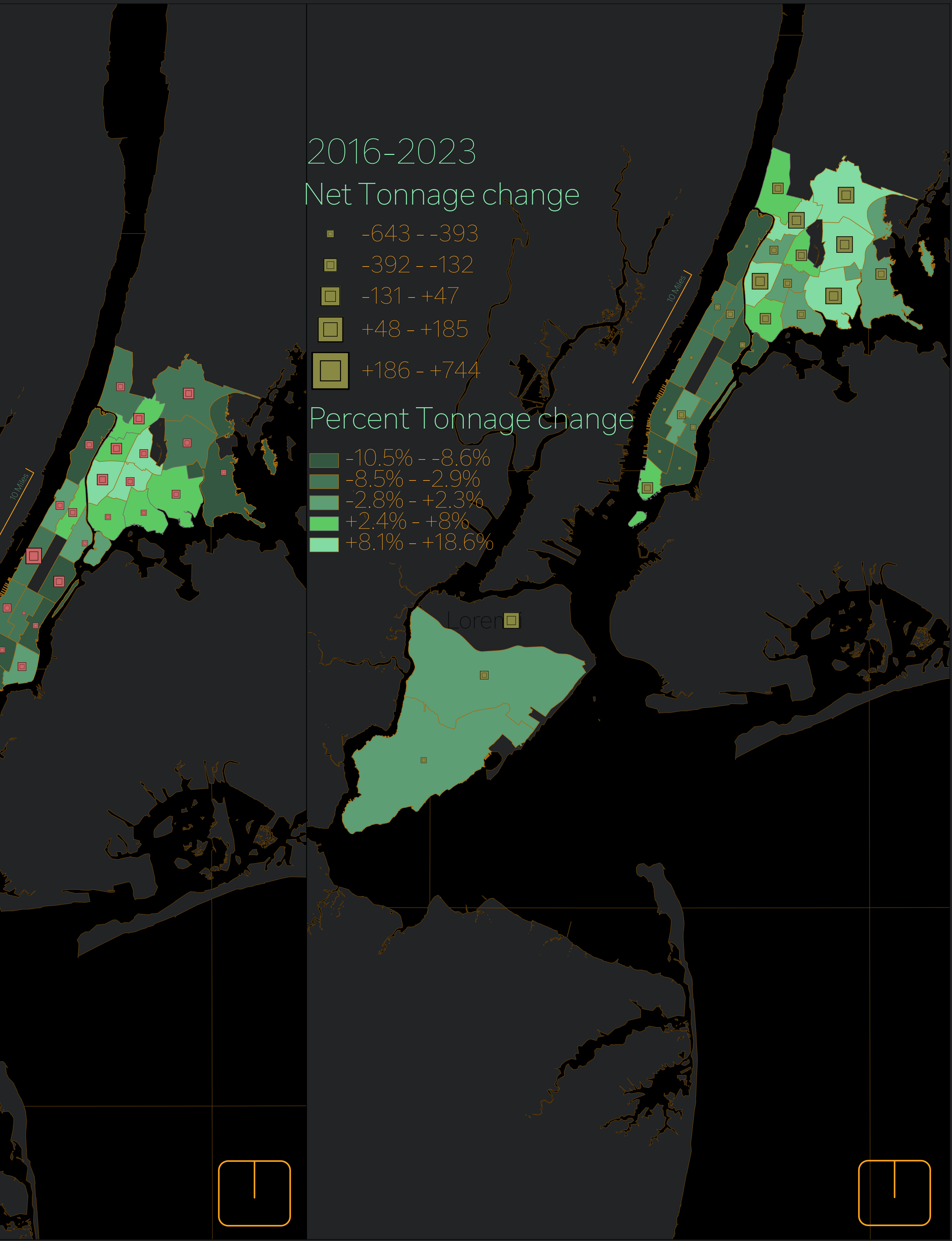
The observed trends in paper recycling across New York City over the last decade reveal a complex narrative regarding the success of the city's Zero Waste plan. While a decline in paper recycling tonnage might suggest an overall reduction in waste generation—a potential positive outcome—it is critical to interrogate this assumption further. The map, which highlights net and percentage changes from 2010–2015, 2015–2016, and 2016–2023, indicates that the results are varied at best. Between 2010 and 2015, substantial reductions in paper recycling occurred across many neighborhoods, with some areas experiencing declines exceeding 1,200 tons and percentage drops reaching as high as -175%. While the subsequent period (2015–2016) showed signs of stabilization and marginal improvement, with fewer areas experiencing dramatic declines, this trend did not persist. From 2016 to 2023, notably the period right after the implementation of the Zero Waste Plan, recycling rates worsened significantly, with some neighborhoods losing up to 2,425 tons and widespread declines ranging from -40% to -72%. These spatial and temporal patterns suggest that, while some areas may have reduced total waste, the broader decline in paper recycling tonnage reveals a concerning regression in the city's waste diversion efforts. The variability across neighborhoods underscores uneven progress and raises questions about the overall effectiveness of New York City's Zero Waste plan, particularly in fostering consistent and sustainable recycling habits citywide.

Below Figure:

The trends in recycling metal, glass, and plastic across New York City, as depicted in the maps below, from 2010–2015, 2015–2016, and 2016–2023, highlight an inconsistent and, at times, concerning trajectory regarding the city's Zero Waste plan goals. While a reduction in net tonnage might signal decreased waste generation overall—a theoretically positive outcome—it is crucial to examine the detailed spatial and percentage changes reflected in these maps. From 2010 to 2015, many neighborhoods experienced significant declines in recycling rates, with net losses reaching up to -632 tons and percentage drops of -10% to -42.5%, indicating a noticeable regression. If the amount of total refuse had also reduced, this would be a good thing, but since that is not what we see, we see slight fluctuations in total refuse and a decrease in recycling rates, a more dismal outcome may be indicated.

The period between 2015 and 2016 saw a mix of outcomes; some areas stabilized or showed modest improvement, with tonnage changes ranging from -70 to -299 tons and percentage declines less severe, clustering around -5% to -30%. However, these gains were largely short-lived. By 2016–2023, a broader and more pronounced decline in recycling tonnage reemerged, with some neighborhoods losing as much as -633 tons and widespread percentage decreases reaching up to -44%. The uneven distribution of recycling declines across neighborhoods raises important questions about the systemic effectiveness of New York City's Zero Waste initiatives. While isolated areas may reflect reduced total waste generation, the overall trend indicates persistent challenges in achieving meaningful and sustainable improvements in recycling behavior, particularly for materials like metal, glass, and plastic. The data suggests that recycling efforts remain inconsistent and insufficient to offset broader declines, highlighting the need for targeted interventions and equitable resource allocation to support waste diversion goals across all boroughs.


Have New Yorkers Gotten Better at Recycling Metal, Glass and Plastic?
2010-2015
Net Tonnage change
-362
-361 - +322
+323 - +537
+538 - +832
+833 - +1078
Percent Tonnage change
-7.1% - +5.5%
+5.6% - +14%
+14.1% - +22.4%
+22.6% - +34.6%
+34.7% - +60.8%
2015-2016
Net Tonnage change
60 - 135
136 - 238
239 - 409
410 - 575
576 - 861
Percent Tonnage change
+2.3% - +5.8%
+5.9% - +8.6%
+8.7% - +10.6%
+10.7% - +16.7%
+16.8% - +22.1%



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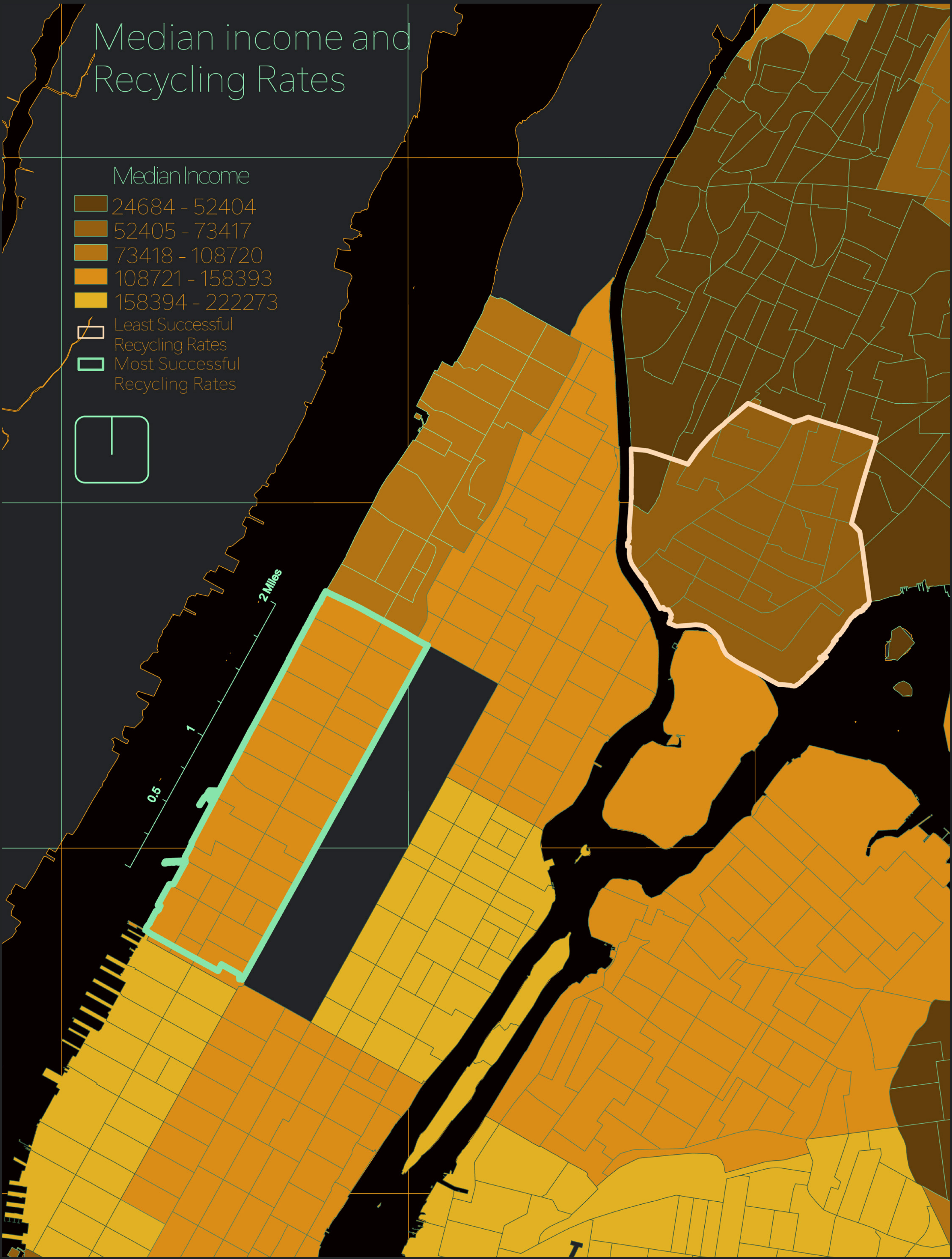

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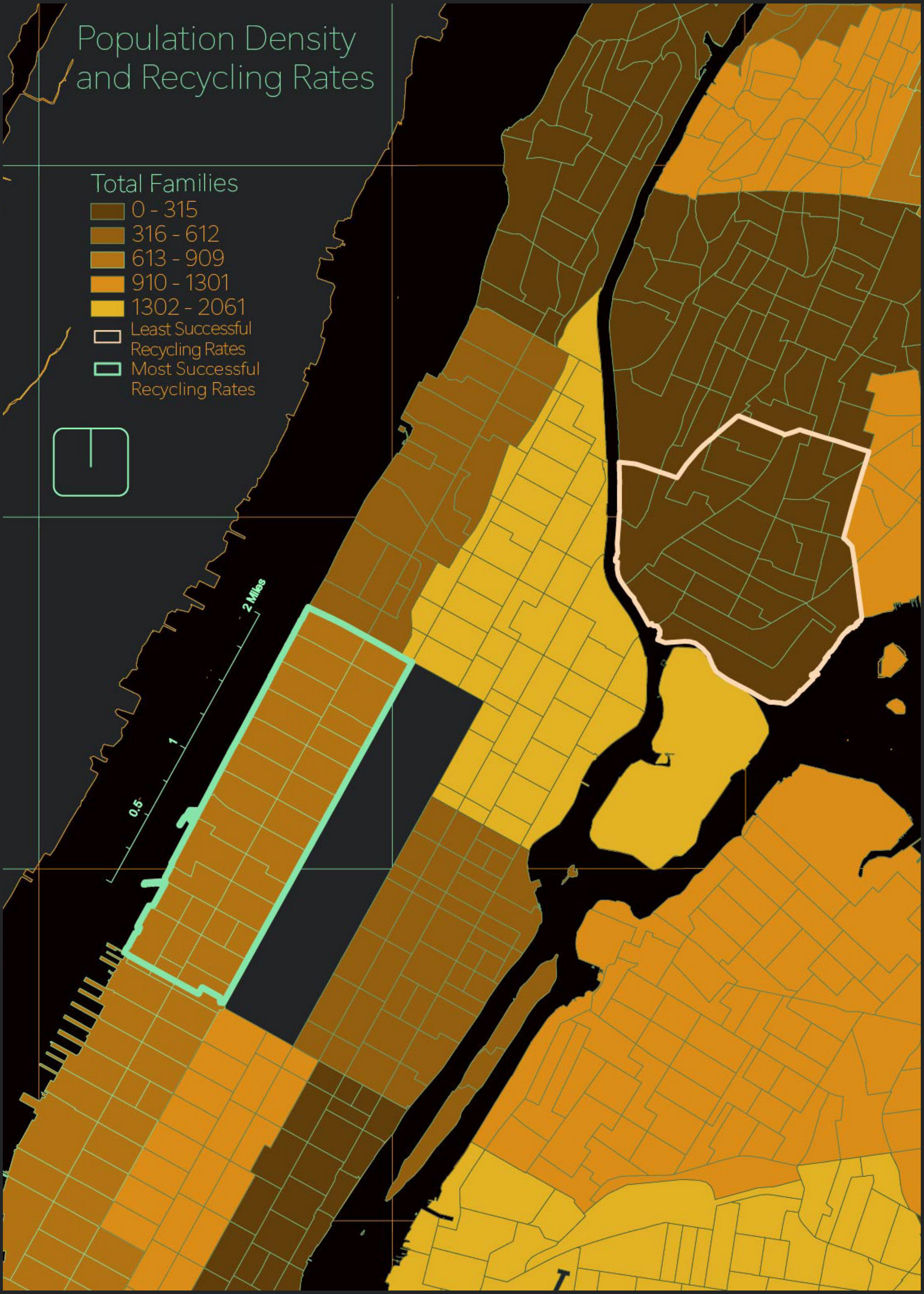
United States Census Bureau. American Community Survey 5-Year Estimates (2015-2019). U.S. Department of Com-


Population Density
and Recycling Rates
Total Families
0 - 315
316 - 612
613 - 909
910 - 1301
1302 - 2061
Least Successful
Recycling Rates
Most Successful
Recycling Rates
0.5
1
2 Miles

The income map (above) reveals a pronounced disparity in median income across New York City, with higher-income neighborhoods exhibiting significantly better recycling rates, while lower-income areas face consistently lower recycling success. These patterns likely stem from systemic inequities in infrastructure, educational outreach, and access to resources that facilitate recycling participation.

In contrast, the density map illustrates a smaller but still meaningful variation in household density, where high-density neighborhoods generally report lower recycling rates. This trend may be attributed to logistical challenges inherent to densely populated areas, such as limited space for waste separation, insufficient infrastructure, and barriers to consistent recycling services.

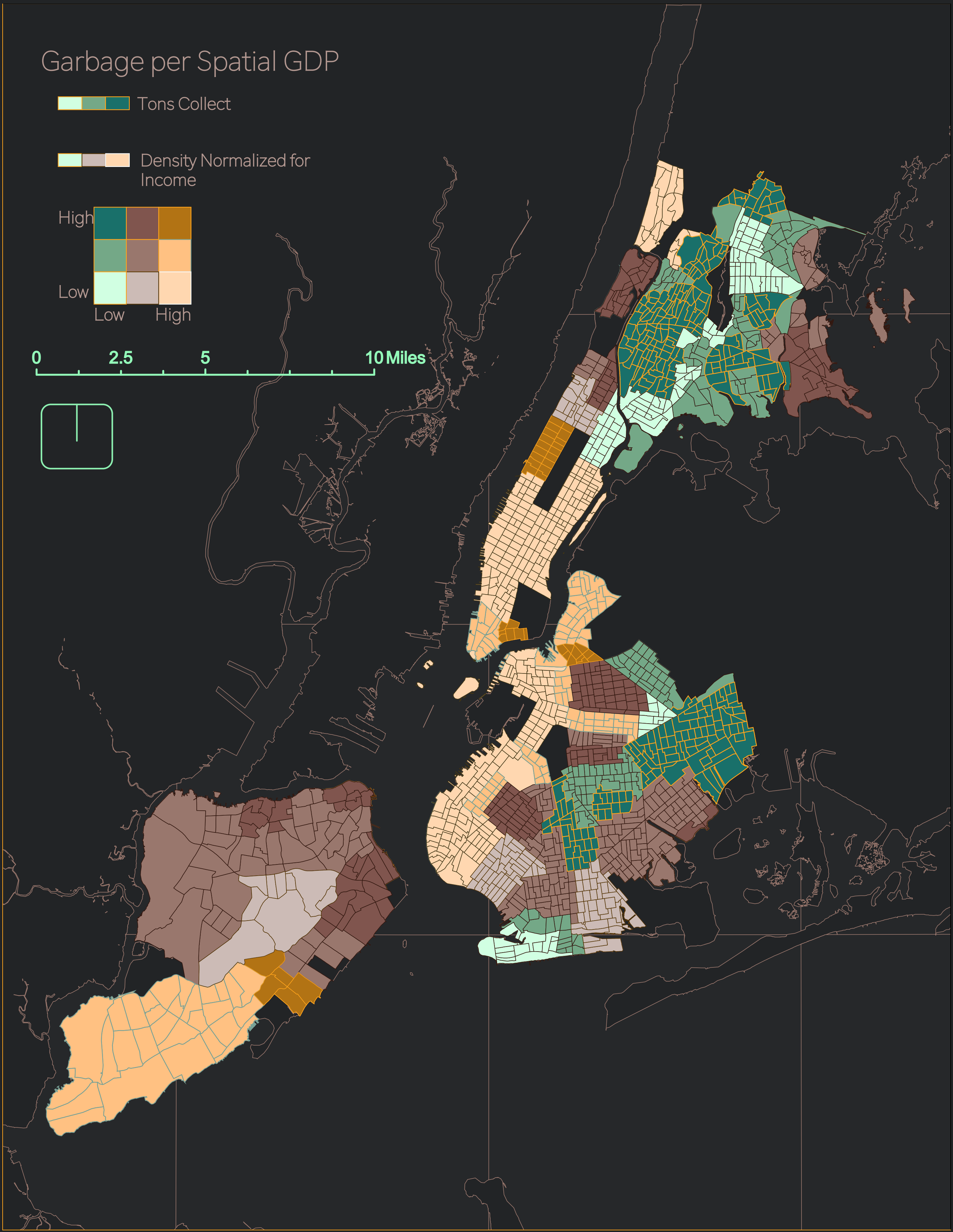
Taken together, these maps suggest that recycling success in New York City is strongly influenced by both income and density, underscoring the interconnected role of socio-economic and structural factors. Addressing these disparities will require targeted policies that enhance infrastructure in high-density areas and expand resources and outreach efforts in lower-income neighborhoods to ensure equitable and sustainable improvements in recycling outcomes citywide.

To the right, I combine these variables to take a deeper look at these relationships. This bivariate map combines waste tonnage collected in 2022 with population density normalized by income, effectively visualizing waste generation relative to spatial GDP. By integrating these two variables, the map highlights areas where waste tonnage disproportionately exceeds or aligns with economic output per geographic unit.

The map is particularly useful for identifying spatial inequities in waste management. Areas shaded in dark brown represent neighborhoods with high density and low income that collect substantial waste tonnage, revealing significant burdens relative to their economic capacity. Conversely, light green areas indicate neighborhoods with lower waste tonnage relative to higher spatial GDP, reflecting more efficient waste generation per unit of economic activity.

By framing waste collection in relation to spatial GDP, the map underscores the uneven distribution of waste management challenges and highlights the role of socio-economic and spatial factors in determining waste generation across New York City.

[Note: This map uses Census Data and Refuse Data, allowing for the inclusion of Brooklyn that is not present in the other maps. Therefore, the data from Brooklyn only shows normalized population density.]



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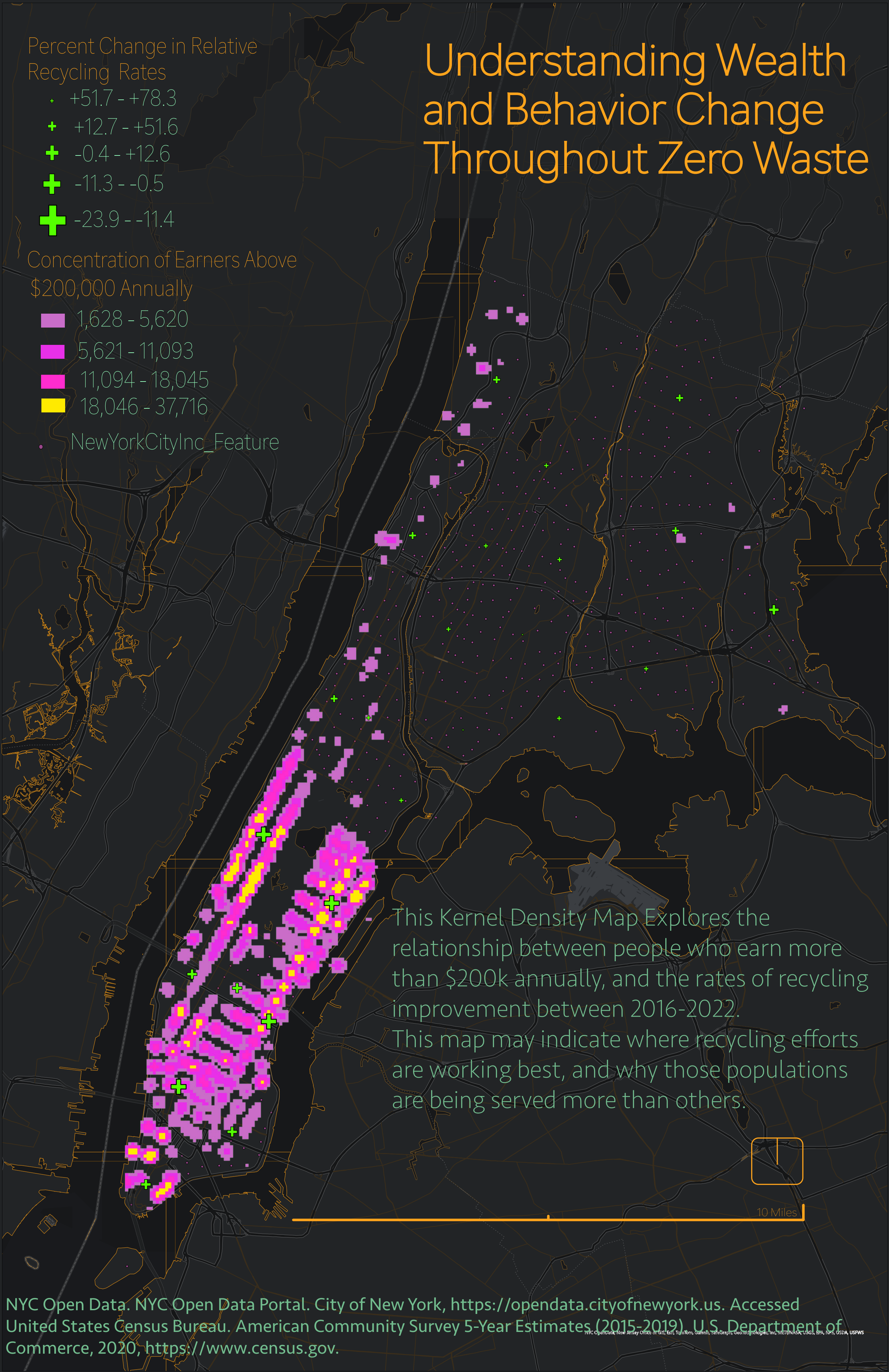
Understanding Wealth and Behavior Change Throughout Zero Waste



This Kernel Density Map Explores the relationship between people who earn more than $200k annually, and the rates of recycling improvement between 2016-2022.
This map may indicate where recycling efforts are working best, and why those populations are being served more than others.

NYC Open Data. NYC Open Data Portal. City of New York, https://opendata.cityofnewyork.us. Accessed
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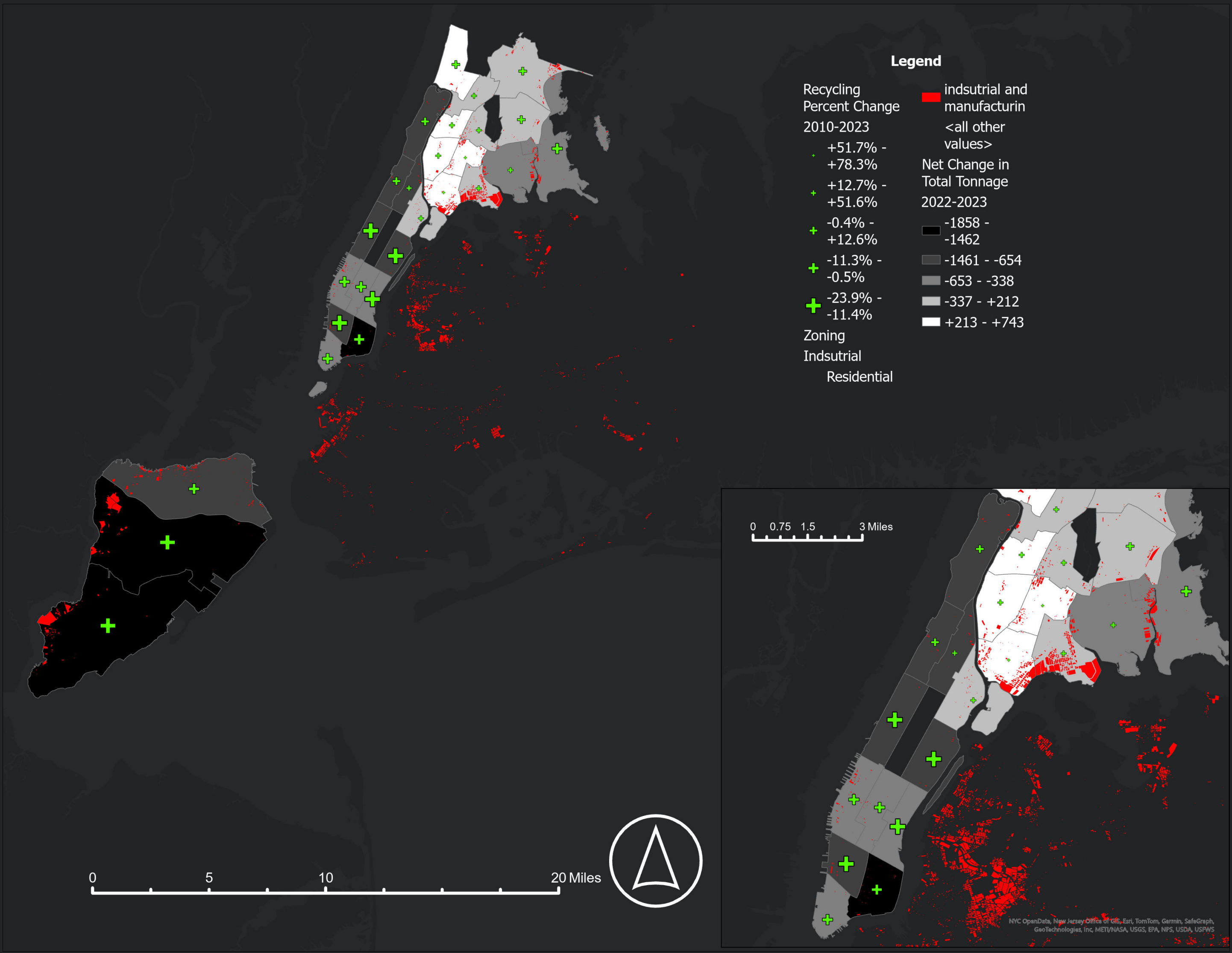
This map demonstrates the relationship between zoning and recycling habits, focusing on areas with manufacturing and industrial zoning, which are highlighted in red below. The analysis revealed a correlation between these zones and lower success rates for recycling programs. While this trend may reflect broader socioeconomic disparities, it also raises questions about whether industrial facilities are managing their waste responsibly. Further investigation is needed to determine the extent of this issue and its underlying causes.



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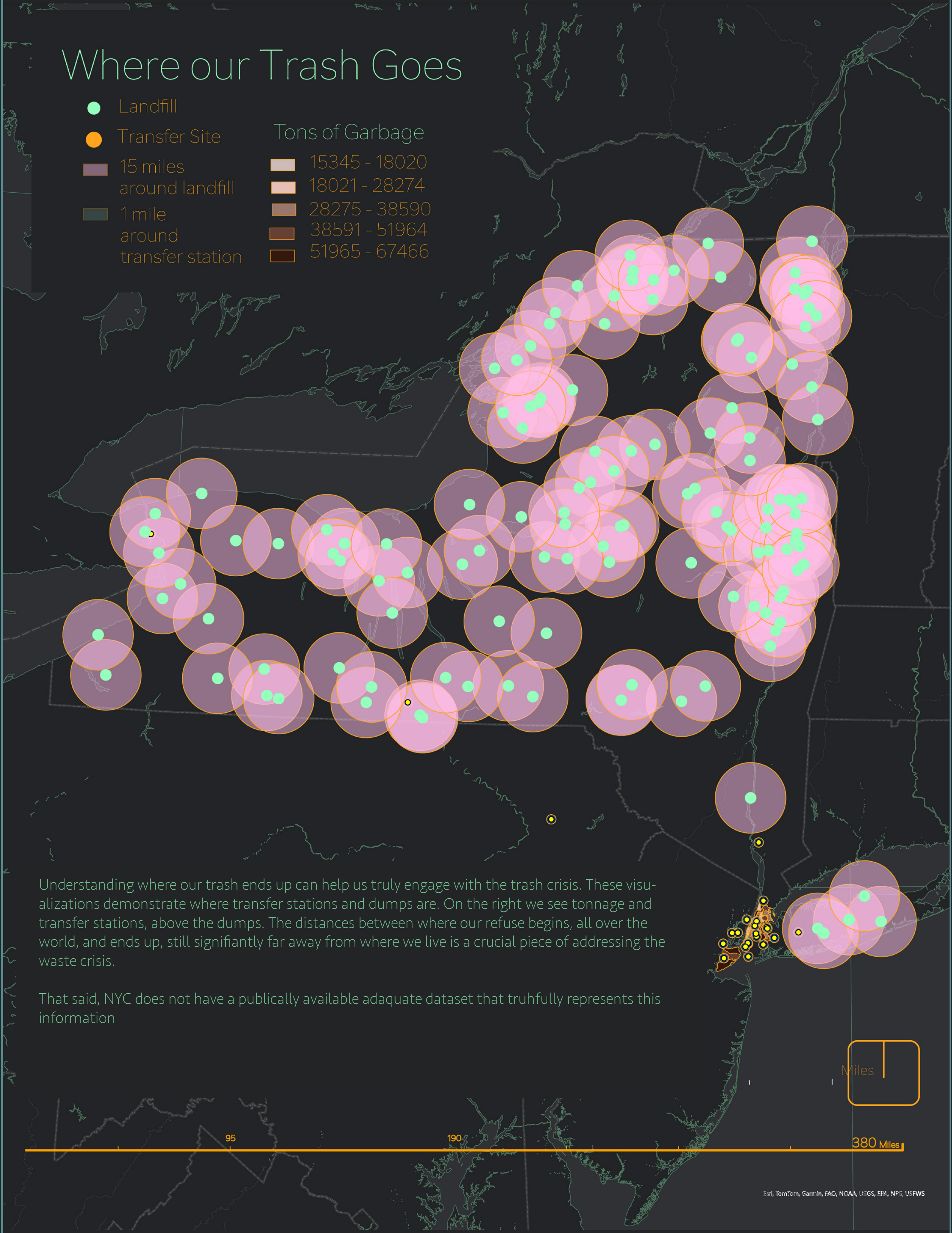

Understanding where our trash ends up can help us truly engage with the trash crisis. These visualizations demonstrate where transfer stations and dumps are. On the right we see tonnage and transfer stations, above the dumps. The distances between where our refuse begins, all over the world, and ends up, still signifiantly far away from where we live is a crucial piece of addressing the waste crisis.

That said, NYC does not have a publically available adaquate dataset that truhfully represents this information

NYC Open Data. NYC Open Data Portal. City of New York, https://opendata.cityofnewyork.us. Accessed
United States Census Bureau. American Community Survey 5-Year Estimates (2015-2019). U.S. Department of Commerce, 2020, https://www.census.gov.

Results of Zero Waste:

In 2024, marginal progress has been made, but significant change remains out of reach, revealing the structural and political barriers that must be addressed to truly tackle the waste crisis. Despite years of targeted interventions and investments, diversion rates fall far short of the ambitious targets set in 2015. The curbside and containerized diversion rate stands at 17.5%, while the overall Department of Sanitation (DSNY)-managed diversion rate—including organics, electronics, and textiles—reaches only 20.6%, well below the national average (DSNY, Zero Waste Report, 2024). These figures underscore the inadequacy of downstream solutions and highlight the urgent need for transformative, upstream strategies to reduce waste generation across all sectors.

The ZWP programs are ambitious but have had mixed results in implementation. Residential and commercial waste diversion, with organics diversion, has emerged as a persistent challenge. Food scraps alone account for 36% of NYC's residential waste stream (DSNY, Waste Characterization Report), yet citywide diversion rates for organics remain stagnant at 4.1% (DSNY, Zero Waste Report, 2024). While the Smart Compost Bins program and expanded curbside composting have increased accessibility, participation remains inconsistent across boroughs. Non-curbside initiatives demonstrate slightly better success, achieving a 9.9% capture rate, but systemic gaps in infrastructure and outreach persist. The lack of participatory planning and transformative ideological shifts has perhaps led to these low results.

The 2019 Commercial Waste Zone (CWZ) program requires businesses to separate organics and recyclables, aiming to shift waste diversion accountability onto commercial producers, this policy shift represents a move in the right direction by beginning to focus on upstream contributors to waste. However, weak enforcement and uneven implementation have limited its impact. To address these shortcomings, DSNY is rolling out mandatory organics separation citywide, with enforcement mechanisms slated for 2025. Success, however, hinges on robust infrastructure investment, equitable access to programs, and sustained public education efforts to ensure participation and compliance (DSNY, Zero Waste Report, 2024).

Material-specific recycling programs present similarly uneven results. Electronics recycling has performed well, achieving a 38% capture rate, yet textiles—despite their significant potential—lag far behind at only 4% (DSNY, Recycling Diversion and Capture Rates, 2024). Textiles still constitute 5% of the city's residential waste stream, illustrating a persistent challenge. Additionally, mixed-material and non-recyclable plastics pose significant obstacles to achieving zero waste, underscoring the need for stronger upstream interventions, such as producer accountability for non-recyclables and resource regulation.

What is more, borough-level disparities, and the underlying histories of environmental and economic injustice, exacerbate implementation challenges. In The Bronx the diversion rate is reported as only 14.1% compared to Manhattan's 19.6%, reflecting inequities in outreach, infrastructure investment, and participation opportunities (DSNY, Waste Composition Breakdown, 2023). Addressing these disparities is not only required to ensure equitable progress towards Zero Waste, but also represents the uneven realities of a linear and extractive economy.

That said, policy shifts are on the horizon. The expanded implementation of the Commercial Waste Zone (CWZ) program seeks to address the commercial sector's disproportionate contribution to NYC's waste stream. By mandating private haulers to offer competitive organics and recycling services, the program creates incentives for businesses to adopt sustainable practices (CWZ Implementation Plan, 2023). Additionally, initiatives like Extended Producer Responsibility (EPR) for packaging and e-waste aim to shift accountability upstream, requiring manufacturers to design products with recyclability and minimal waste generation in mind (DSNY, Zero Waste Report, 2024).

Despite these steps, the ZWP remains reactive rather than transformative, addressing the symptoms of the waste crisis without confronting its root causes. It operates within the logic of the Climate Leviathan, failing to challenge the neoliberal

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