The City of New York
Executive Budget
Fiscal Year 2027

Zohran Kwame Mamdani, Mayor

Mayor's Office of Management and Budget
Sherif Soliman, Director

Technical Appendices:
New York City Climate Budgeting

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CLIMATE BUDGETING INTAKE FORM

Overview

To inform the city's Climate Budgeting process, the NYC Mayor's Office of Management and Budget (OMB) developed a Climate Budgeting Intake Form that allows for a more uniform evaluation of the climate impacts of funding decisions. The form was designed to help evaluate funding proposals, understand where additional information is needed, and support the assessment of impacts, cost-effectiveness, and additional benefits and considerations. City agencies use the Climate Budgeting Intake Form to submit information on expense and capital funding needs for projects and programs that are relevant for meeting the city's climate goals. The form accompanies expense and capital requests that meet the following criteria:

1. Requests that impact greenhouse gas emissions and/or resiliency to coastal flooding, stormwater flooding, or heat
2. New projects located in one or more high-risk locations
3. New building projects involving heating, ventilation, and air conditioning (HVAC) or appliances or building envelope work
4. Incremental needs associated with incorporating resiliency design or green building standards into an existing project

Project Examples

Examples of the types of work that may impact emissions and resiliency are listed below.

- **Building & Facilities:** HVAC; envelope, roof, and window replacement; flood protection; new construction
- **Energy & Utilities:** Solar panels, hydropower, battery storage, cogeneration plants, wind power
- **Equipment:** Emergency generators, construction equipment, electric vehicle chargers
- **Green & Natural Spaces:** Tree planting or removal, wetland restoration, flood mitigation, reforestation, heat mitigation in parks
- **Green Infrastructure:** Rain gardens, bioswales, retention basins, permeable pavement
- **IT & Technology:** IT or technology to support flood mapping, new data centers, emissions tracking, local law compliance, other climate initiatives
- **Public Space & Recreation:** Playground water features, water fountains, flood or heat mitigation in public spaces
- **Sewers & Grey Infrastructure:** Sewer buildout, catch-basin cleaning, combined sewer overflow management

- **Site Development:** Multi-scope site development (including utilities, buildings, green space, and street work) in high-risk flood or heat areas
- **Street & Road Projects:** Bike lanes, bus infrastructure, traffic mitigation measures, heat or flood mitigation strategies
- **Vehicles:** Light-, medium-, and heavy-duty vehicles, electric vehicles, hybrid vehicles, ferries, aircraft, off-road vehicles
- **Water Supply Infrastructure**: Water mains, aqueducts, or reservoirs that impact flood resiliency
- **Waterfront Assets:** Coastal protection projects, docks and piers, coastal infrastructure
- **Other:** Waste, addressing fugitive emissions, initiatives to reduce consumption-based emissions (food, concrete, steel)
- **Programmatic (Expense):** Staffing to support sustainability or resiliency programs, green workforce, consultant services, reporting

High-Risk Locations

The Climate Budgeting Intake Form considers a project location to be high-risk if the corresponding Community District is designated as highly vulnerable to extreme heat or flood according to the following definitions:

High Heat Risk

The city's Heat Vulnerability Index (HVI) measures neighborhood risk from the impacts of extreme heat.[1] This measure was developed by the NYC Health Department. A capital project is considered to be potentially at high risk for heat for the Climate Budgeting process if it takes place in one or more Community Districts with a HVI equal to or greater than four (on a scale of one through five).

High Flood Risk and Waterfront

Flood risk captures elevated neighborhood risk from the combined impacts of coastal and stormwater flooding projections. A capital project is considered to be potentially at high risk for flooding if located in one or more Community Districts with at least 30 percent area coverage within the estimated 2050s 100-year floodplain and 2050s high-tide floodplain, and 10 percent chance "Moderate" stormwater flood scenario. [2] [3] All capital projects located on the waterfront, are considered to be potentially at high risk for flooding, independent of whether they are designated as located in a high-flood-risk area. This method provides a simple approach to identify projects with potential flood risk in a way that aligns with information in the city's centralized accounting and budgeting system, known as the Financial Management System (FMS), which includes the Community District for each capital project. Projects must be further evaluated for flood risk depending on the specifics of each location.

FIGURE 1 | HIGH-RISK COMMUNITY DISTRICTS BY HAZARD CATEGORY

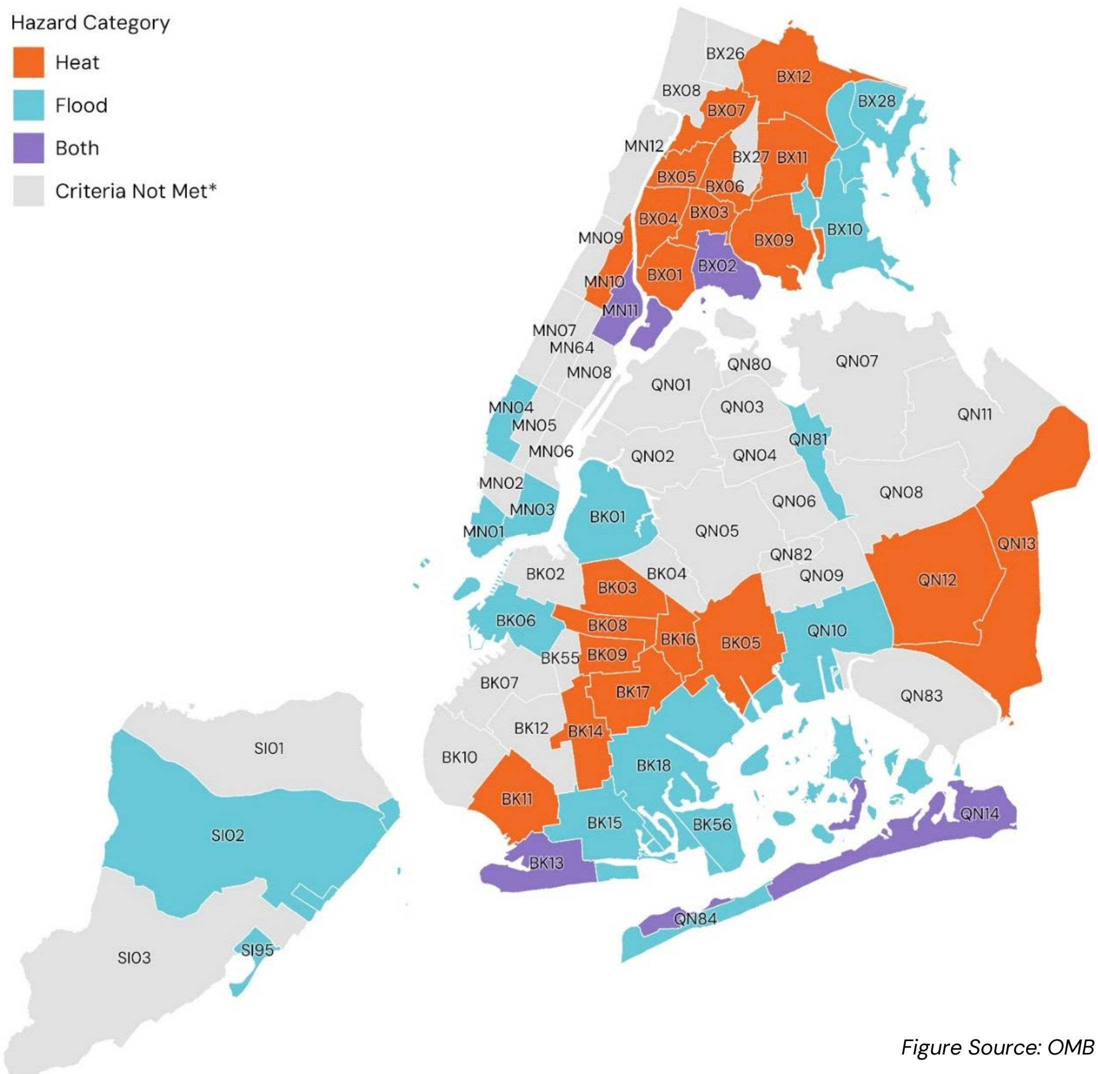

Figure Source: OMB

*Vulnerability Criteria requirements: Heat Vulnerability Index Score of 4-5 OR more than 30 percent of land area covered within the NPCC3's estimated 2050s medium-high sea-level rise floodplain and 2050s high tide, and 10 percent moderate stormwater flood scenario (2.13 inches in one hour).[5]

High-Heat-Risk Community Districts: BK03, BK05, BK08, BK09, BK11, BK13, BK14, BK16, BK17, BX01, BX02, BX03, BX04, BX05, BX06, BX07, BX09, BX11, BX12, MN10, MN11, QN12, QN13 & QN14

High-Flood-Risk Community Districts: BK01, BK06, BK13, BK15, BK18, BK56, BX02, BX10, BX28, MN01, MN03, MN04, MN11, QN10, QN14, QN81, QN84, SI02, SI95

Intake Form Questions

The questions in the Intake Form are broken into three main sections: questions asked for all identified needs that may implicate the city's climate goals, followed by questions specific to capital proposals, and questions specific to requests impacting buildings.

All identified relevant funding proposals are required to include responses to the following requests:

A. What is the request amount by fiscal year?
B. Project/program name
C. Please describe any other sources of funding expected to support this project/program
D. If this need is time-sensitive, please explain why and the implications of a delay
E. Does this request support compliance with a local law, mandate, or stated climate goal of the city?
F. Does this request support any of the environmental justice (EJ) topics identified through the city's Environmental Justice NYC (EJNYC)[6] report, or otherwise support EJ in the city?
G. What type of work does this project involve?
H. What is this request's expected impact on greenhouse gas emissions?
I. What is this request's expected impact on heat and/or flood resiliency?
J. Please explain how this request impacts greenhouse gas emissions and/or resiliency towards flooding or heat

All identified relevant funding capital proposals are required to include responses to the following requests:

A. Location of project
B. Is the project primarily located in at least one of the high-risk Community Districts? If yes, which?
C. Will this project follow any guidelines for resilient design, such as the Climate Resiliency Design Guidelines (CRDG)[7], Envision[8], or any specific guidelines the agency may use?
D. Is the project anticipated to include design strategies that address the impact of coastal flooding, storm surges, or heavier rainfall?
E. Is the project anticipated to include creating more shaded areas, planting vegetation, installing air -conditioning, or using materials that reflect sunlight to keep surfaces cooler?

All identified relevant funding in buildings are required to include responses to the following requests:

A. Are Local Law 51 of 2023 standards incorporated or planned to be incorporated into the scope of work, design, and construction of this project?
B. Does this project involve work on a building's envelope, windows, or roof?
C. Does this project involve work on heating equipment?
D. Does this project involve work on hot water equipment?
E. Does this project involve work on appliances?

Heating Equipment/Hot Water Equipment/Appliances:

F. What is the existing equipment?
G. What is the proposed replacement equipment?
H. What percentage of the building will be served by the proposed replacement equipment?
I. What is the upfront unit cost for the proposed replacement equipment?

J. What is the total projected annual operation and maintenance costs for the proposed replacement equipment?
K. What is the full useful life of the proposed replacement equipment?

GREENHOUSE GAS EMISSIONS AND CLIMATE RESILIENCY BUDGET TRACKING

Overview

The OMB Environmental Sustainability and Resiliency Task Force tracks capital and expense funding for investments planned to help the city advance its emission reduction and climate resiliency goals. This enables understanding of climate-related spending across the entire city budget, providing more context for future budget decisions. For emissions reductions, funding is tracked by major sources of emissions. For resiliency, funding is categorized based on the primary climate risks described by the New York Panel on Climate Change (NPCC), plus planning and preparedness work.[9]

Climate Resiliency Categories:

- Coastal Flooding
- Stormwater Flooding
- Heat
- Planning and Preparedness

Emissions Categories:

- Buildings and Facilities
- Transportation
- Energy
- Waste

Tracking funding across agency budgets and city budget structures poses various challenges as described below. Tracking is continuously updated to reflect changes made during the city's financial and capital plans and advancements in internal processes. Both city funds and non-city funding sources are included.

Capital Tracking

Capital project tracking is closely related to the evaluation of capital projects via the annual Climate Alignment Assessment (CAA) (see page 11). Capital projects that are rated as Aligned with either Net-Zero Emissions, Flood Resiliency, or Heat Resiliency goals in the CAA are also tracked as climate investments in a corresponding category (see Figure 2: Capital Project Tracking Categories). These investments are reported on in the Climate Budgeting publication as those directly contributing to decarbonization, flood resiliency, and heat resiliency. The city's capital budget is organized in multiple structures. To track climate-related investments, OMB uses project IDs—unique project identifiers assigned in the city's centralized accounting and budgeting system, known as the Financial Management System, or FMS—as well as budget lines, which denote specific uses of funding.

A limitation of this approach is that it does not capture funding for discrete climate-related elements within larger capital projects. For example, a project ID for a facility renovation project may include relevant scope, such as energy-efficient windows, alongside other unrelated scope such as bathroom renovations. This project ID would not be included in capital project tracking reporting on direct investments, but its positive climate impact would be recognized using the Aligned Component rating in the CAA. Capital project tracking, therefore, is not intended to reflect the total sum of all climate-related capital investments in the city's capital portfolio.

There are a few exceptions where this challenge is addressed by tracking funding by budget lines within a project ID. Budget lines are identifiers of capital units of appropriation, which reflect discrete projects or similar types of work done at multiple locations. Each budget line represents a particular program, purpose, activity, or institution in an agency's budget. A project ID can contain multiple budget lines. In certain circumstances, OMB uses budget lines to track climate-related capital investments. For example, a capital project for street and utility reconstruction may include budget lines specific to sewer buildout, water main extensions, sidewalk construction, and street resurfacing. In this case, OMB tracks only the funding allocated to the sewer budget line, which contributes to stormwater flooding resiliency.

The table below details the methodology for capital project tracking across categories:

FIGURE 2 | CAPITAL PROJECT TRACKING CATEGORIES

<table>
<tr><th></th><th>Category</th><th>Methodology</th></tr>
<tr><td rowspan="4">Climate Resiliency</td><td>Coastal Flooding</td><td>Large-scale neighborhood coastal flood protection, including:
Brooklyn Bridge-Montgomery Coastal Resilience
East Side Coastal Resiliency
FiDi & Seaport Coastal Resilience
The Battery Coastal Resilience
Red Hook Coastal Resiliency
Tottenville Shoreline Protection Project
The Raised Shorelines initiative
Coastal protection projects managed by the U.S. Army Corps of Engineers
Other coastal resiliency projects, including:
Harlem River Park and Greenway
East River Esplanade
Riverside Park
Bayswater Park
the reconstruction of piers, seawalls, and other coastal infrastructure</td></tr>
<tr><td>Stormwater Flooding</td><td>Sewer buildout in Southeast Queens and other priority areas, green infrastructure, tree planting and replacement, cloudburst management projects, wetland restoration, the Bluebelts program, flood protection for buildings, other flood resiliency initiatives</td></tr>
<tr><td>Heat</td><td>Tree planting and replacement, wetland restoration, public pools, cooling upgrades in buildings, cooling features in public spaces</td></tr>
<tr><td>Planning & Preparedness</td><td>Emergency generators and other planning and preparedness projects</td></tr>
<tr><td rowspan="4">Emissions</td><td>Buildings</td><td>Decarbonization, electrification, and energy efficiency projects in city facilities; includes projects fully or partially funded by the Department of Citywide Administrative Services (DCAS) Accelerated Conservation and Efficiency (ACE) program</td></tr>
<tr><td>Energy</td><td>Solar, wind, hydroelectric, and other renewable energy projects</td></tr>
<tr><td>Transportation</td><td>Electric vehicles (EVs), fleet fuel efficiency

EV charging stations for city fleet and private vehicles, bike lane infrastructure, bus lane infrastructure, ferries infrastructure</td></tr>
<tr><td>Waste</td><td>Composting, emissions-reducing projects from solid waste, fugitive emissions-reducing projects from wastewater resource recovery facilities</td></tr>
</table>

Figure Source: OMB

Expense Tracking

OMB tracks investments in the expense budget using the same categories as capital investment tracking. The expense budget has certain dedicated budget structures for climate investments that OMB tracks centrally. However, typically expense funding supports programs or operations that are a combination of climate-related work and other work. As a result, the methodology for tracking each climate category is individualized. The expense programs tracked in the Climate Budgeting publication are not meant to reflect the total sum of all climate-related expense investments.

OMB began tracking expense climate investments in December 2021 when OMB's Environmental Sustainability and Resiliency Task Force was established. This is the starting point for tracked expense investments where there is otherwise no clear historical predecessor.

There are cases where there is a clear point-in-time to begin tracking historical investments in expense-funded climate programs. For example, Hurricane Ida in September of 2021 led to an increased focus on flood resiliency and a prioritization of strategies including expansion of grey and green infrastructure. New investments after Hurricane Ida are therefore included under Stormwater Flooding.

OMB will continue to track these programs over time, and any new programs that fall into the scope of these categories will be added as necessary.

The table below details the methodology and timeline for expense tracking across categories:

FIGURE 3 | EXPENSE PROGRAM TRACKING CATEGORIES

	Category	Methodology
Climate Resiliency	Coastal Flooding	Funding for the Bureau of Coastal Resiliency, including for developing standards for construction of coastal infrastructure. Current funding allocated as of the FY 2027 Executive Plan.
	Stormwater Flooding	Funding added for programs to address flooding from extreme rain events added since Hurricane Ida (September 2021), such as green infrastructure and Bluebelt maintenance. Funds reflect Fiscal Year 2027 allocations.
	Heat	Funding allocated to NYC Parks Department's programs that support tree work and maintenance, wetlands, and other cooling programs. Includes personal services and other than personal services. Current funding allocated as of the FY 2027 Executive Plan. Funds reflect Fiscal Year 2027 allocations.
	Planning & Preparedness	Climate-related planning efforts including funding to make businesses more resilient, a program to protect vulnerable New Yorkers during extreme weather events, and funding for long-term climate planning. Current funding allocated as of the FY 2027 Executive Plan.
Emissions	Buildings	The DOB Bureau of Sustainability, DCAS Division of Energy Management, and programs to provide decarbonization assistance to building owners. Current funding allocated as of the FY 2027 Executive Plan.

	Energy	Funding allocated for clean and renewable energy (including Renewable Energy Certificate purchases, and wind, solar, and geothermal power) since the city commitment to power its operations with 100-percent renewable electricity made in the city's *1.5 Climate Action Plan* (2017).[10] Current funding allocated as of the FY 2027 Executive Plan. Funds reflect Fiscal Year 2027 allocations.
	Transportation	Funding for electric vehicles and charging infrastructure, renewable diesel for the city fleet, and the expansion of micromobility and bus networks. Funds reflect Fiscal Year 2027 allocations.
	Waste	Funding added for organics collection and community composting. Initiatives since FY 2016 Preliminary Plan. Funds reflect Fiscal Year 2027 allocations.

Figure Source: OMB

CLIMATE ALIGNMENT ASSESSMENT

Overview

As part of the Climate Budgeting process, OMB conducts an annual Climate Alignment Assessment (CAA) of New York City's planned capital investments. This assessment provides a citywide view of how planned spending aligns with long-term climate needs. Each capital project in the FY 2026–2030 Five-Year Capital Plan has been evaluated to determine if it supports or meets relevant goals or standards in each of three climate priority areas: Net-Zero Emissions, Flood Resiliency, and Heat Resiliency. Examples of the city's goals and standards include:

- The commitment to achieve net-zero greenhouse gas emissions by 2050
- The commitment to achieve PlaNYC initiatives (e.g., 30 percent canopy cover)
- The city's Climate Resiliency Design Guidelines (CRDG[11])
- Agency-specific design guidelines that consider future flood or heat risk projections

This exercise also tracks Environmental and Social Benefits related to projects (see page 19).

Climate Priorities and Assessment Ratings

How projects align with each climate priority—achieving new-zero greenhouse gas emissions, improving resiliency to flooding, and improving resiliency to extreme heat is considered separately. In some instances, the same project may be rated differently under each climate priority.

Projects Pending Rating
Projects marked Pending Rating may impact the city's climate priorities, but their impact cannot be assessed at this time. Specific climate-related details are needed to determine alignment. It is common for details to not yet be available when projects are in the early stages of design.

Special Projects
The city funds some public authorities, quasi-public entities, and unique programs through grants, loans, and lump payments. Due to their unique financial structures, these are marked as Special Projects and are evaluated on a case-by-case basis.

Net-Zero Emissions

FIGURE 4 | NET-ZERO EMISSIONS GOALS

Primary Goal Achieve net-zero greenhouse gas emissions by 2050	
Supporting Standard or Goal	**Source**
All-electric new construction	Local Law 154 of 2021[12]
Fossil-fuel-free city operations	Executive Order 52 of 2020[13]
Light-, medium-, and heavy-duty fleet electrification	PlaNYC, NYC Clean Fleet Plan
Zero-emissions electricity for city operations	NYC 1.5 Climate Action Plan
Solar capacity on city buildings	PlaNYC

Figure Source: OMB

In 2017, New York City released a city-scale climate action plan explicitly intended to comply with the Paris Agreement's 1.5°C goal. [14] The plan established the target of achieving net-zero emissions citywide by 2050. Achieving net-zero means directly reducing Scope 1 and 2 emissions to as close to zero as technically feasible and finding meaningful ways to compensate for residual emissions.

- Scope 1 emissions: Greenhouse gases emitted within New York City. Scope 1 emissions include direct emissions, such as burning fossil fuels for heat and driving gas-powered cars. These emissions may be decreased through projects like heat electrification and switching to electric vehicles or sustainable modes of transit.
- Scope 2 emissions: Greenhouse gases emitted inside or outside of New York City as a result of the city's consumption of electricity or district steam from the local utility. Changes in electricity use may increase or decrease Scope 2 emissions.

The analysis does not yet consider the impacts on Scope 3 emissions, which can include embodied or consumption-based emissions. Scope 3 emissions include the greenhouse gases resulting from mining, harvesting, processing, manufacturing, transporting, and installing goods, services, and materials consumed within New York City.

FIGURE 5 | CLIMATE ALIGNMENT ASSESSMENT: NET-ZERO EMISSIONS RATING

Assessment Rating	Project Criteria	Examples
Aligned	The project's primary intent is to reduce greenhouse emissions, and it is compatible with the city's net-zero goal. Scope that reduces emissions constitutes most or all of the project cost.	• Heat electrification in city facility • Electric vehicle purchase • Purchase of solar panels
Aligned Component	The project contributes to the city's net-zero goal, but emissions reductions are a co-benefit rather than the project's primary intent. The project may include a mix of emissions-reducing scope and unrelated scope.	• Construction of protected bike lanes in support of Vision Zero[15] • Full facility renovation that includes lighting efficiency upgrades
Not Aligned (Short-Term Benefit)	The project offers short-term greenhouse gas emissions reduction benefits but is incompatible with the city's net-zero goal.	• Oil to gas boiler conversion • Hybrid vehicle purchase
Not Aligned	The project is incompatible with the city's net-zero goal.	• Fossil fuel vehicle purchase • Fossil fuel boiler purchase
No Impact	The project does not contain scope that involves greenhouse gas emissions.	• IT upgrades • Sidewalk paving

Figure Source: OMB

Flood Resiliency

FIGURE 6 | FLOOD RESILIENCY GOALS & STANDARDS

Primary Goal	
Bolster long-term resiliency to the impacts of coastal and stormwater flooding	
Supporting Standard or Goal	**Source**
Climate Resiliency Design Guideline (CRDG)	Mayor's Office of Climate and Environmental Justice
100-year flood plain design standards	Federal Emergency Management Agency [16] U.S. Army Corps of Engineers[17]
Agency-specific design standards	e.g. NYC Parks Department Design and Planning for Flood Resiliency[18]
Implement a multilayered strategy for flood resilience	PlaNYC
Improve the health and ecological function of wetlands	PlaNYC

Figure Source: OMB

New York City employs a variety of measures to bolster resiliency to the impacts of storm surges, high tides, sea-level rise, extreme precipitation and other sources of flooding exacerbated by the changing climate. In April 2023, PlaNYC outlined several long-term goals for protecting against flood risk, including protecting the city's waterfront infrastructure and investing in nature-based mitigation measures.

Projects that affect the continuity of essential services and operations during weather-related power outages, floods, storms, or other natural disasters may also be considered to impact flood resiliency.

Projects may be identified as Missed Opportunities to incorporate resilient design elements if they are located in areas with elevated flood risk (high flood risk or waterfront).[1] Projects tagged as Missed Opportunities do not necessarily reduce resiliency or increase vulnerability to climate risks, and this analysis does not suggest these projects should not proceed as intended. This new framework facilitates a broader analysis of location, asset type, and other features, helping the city draw conclusions about gaps in its approach to protecting residents and assets from the risks to which they are exposed.

[1] This differs from the FY 2025 Executive Budget CAA, where projects were identified as Not Aligned, defined as "increasing vulnerability to flooding."

FIGURE 7 | CLIMATE ALIGNMENT ASSESSMENT: FLOOD RESILIENCY RATING

Assessment Rating	Project Criteria	Examples
Aligned	The project's primary intent is to increase flood resiliency, and/or the project furthers one of the resiliency goals in PlaNYC or other plans. If applicable, it is designed to withstand flood risk through the end of its useful life using the CRDG or other equivalent resiliency standards. Resiliency-related scope constitutes most or all of the project cost.	• Neighborhood-wide coastal protection project • Floodproofing building, following CRDG • Green infrastructure installation
Aligned Component	The project contributes to flood resiliency or furthers one of the resiliency goals in PlaNYC or other plans, but resiliency is a co-benefit project rather than the project's primary intent. The project may include a mix of resiliency-related scope and unrelated scope. If applicable, it is designed to withstand flood risk through the end of its useful life using the CRDG or other equivalent standards.	• Playground renovation including tree planting and stormwater retention • Building renovation that including elevating critical systems
Missed Opportunity	The project does not incorporate flood resiliency strategies and is located in an area of elevated flood risk (high flood risk or waterfront).	• Building renovation in a high-flood-risk area, without flood mitigation design features
No Impact	The project does not contain scope that involves flood resiliency.	• Vehicle purchase • Streetlight installation

Figure Source: OMB

Heat Resiliency

FIGURE 8 | HEAT RESILIENCY GOALS & STANDARDS

Primary Goal	
Bolster long-term resiliency to the impacts of extreme heat	
Supporting Standard or Goal	**Source**
Climate Resiliency Design Guideline (CRDG)	Mayor's Office of Climate and Environmental Justice
Heat Emergency Plan	NYC Emergency Management[19]
Maximize access to indoor cooling	PlaNYC
Cool our built environment	PlaNYC
Achieve a 30 percent tree canopy cover	PlaNYC

Figure Source: OMB

New York City is working to protect its assets and residents from the physical and socioeconomic impacts of extreme heat, including increases in heat-related mortality. In April 2023, PlaNYC outlined several goals and strategies for protecting residents against the risks of extreme heat, including improving access to indoor cooling and increasing the city's tree canopy cover.

Projects that affect the continuity of essential services and operations during weather-related power outages, including from heat waves or other natural disasters, may also be considered to impact heat resiliency.

Projects may be identified as Missed Opportunities to incorporate resilient design elements if they are in areas with elevated heat risk (high-heat-risk areas).[2] Projects tagged as Missed Opportunities do not necessarily reduce resiliency or increase vulnerability to climate risks, and this analysis does not suggest these projects should not proceed as intended. This new framework facilitates a broader analysis of location, asset type, and other features, helping the city draw conclusions about gaps in its approach to protecting residents and assets from the risks to which they are exposed.

[2] This differs from the FY 2025 Executive Budget CAA, where projects were identified as Not Aligned, defined as "increasing vulnerability to extreme heat."

FIGURE 9 | CLIMATE ALIGNMENT ASSESSMENT: HEAT RESILIENCY RATING

Assessment Rating	Project Criteria	Examples
Aligned	The project's primary intent is to increase extreme heat resiliency, and/or the project furthers one of the resiliency goals in PlaNYC or other plans. If applicable, it is designed to withstand heat risk through the end of its useful life using the CRDG or other equivalent resiliency standards. Resiliency-related scope constitutes most or all of the project cost.	• Tree planting and maintenance • Upgrade to facility cooling capacity to handle increasing temperatures • Public pool construction •
Aligned Component	The project contributes to extreme heat resiliency or furthers one of the resiliency goals in PlaNYC or other plans, but resiliency is a co-benefit project rather than the project's primary intent. The project may include a mix of resiliency-related scope and unrelated scope. If applicable, it is designed to withstand heat risk through the end of its useful life using the CRDG or other equivalent standards.	• Playground renovation including tree planting and spray showers • Building renovation, including upgrade to cooling capacity to handle increasing temperatures
Missed Opportunity	The project does not incorporate heat resiliency strategies and is located in an area of elevated heat risk (high-heat-risk areas).	• Building renovation in a high-heat-risk area, without cooling
No Impact	The project does not contain scope that involves heat resiliency.	• Vehicle purchase • Streetlight installation

Figure Source: OMB

FIGURE 10 | CLIMATE ALIGNMENT ASSESSMENT: UPDATED RESILIENCY METHODOLOGY

Is This Project Located in a High-Risk Area?
Flood Resiliency: High Flood Risk or Waterfront
Heat Resiliency: High Heat Risk Vulnerability Index (HVI)

Does This Project Contain a Resiliency Component to Address the Risk?

	Yes	No
Yes	**Aligned** **Flood Resiliency Example:** In a high-flood-risk area, a shoreline is raised to prevent coastal flooding. **Heat Resiliency Example:** In a high-heat-risk-area, a public pool is constructed to provide cooling benefits to the community during the summer. **or** **Aligned Component** **Flood Resiliency Example:** In a high-flood-risk area, a large playground renovation also adds trees and bioswales. This increases the area's ability to absorb rainwater during storms. **Heat Resiliency Example:** In a high-heat-risk area, a large playground renovation also adds spray showers and water fountains. This helps visitors stay cool during extreme heat events.	**Aligned** **Flood Resiliency Example:** In a low-flood-risk area, a building is floodproofed against stormwater. **Heat Resiliency Example:** In a low-heat-risk area, a public pool is constructed to provide cooling benefits to the community during the summer. **or** **Aligned Component** **Flood Resiliency Example:** In a low-flood-risk area, a large playground renovation also adds trees and bioswales. This increases the area's ability to absorb rainwater during storms. **Heat Resiliency Example:** In a low-heat-risk area, a large playground renovation also adds spray showers and water fountains. This helps visitors stay cool during extreme heat events.
No	**Missed Opportunity** **Flood Resiliency Example:** In a high-flood-risk area, a building's mechanical systems are renovated without elevating critical equipment located in the basement. **Heat Resiliency Example:** In a high-heat-risk-area, a playground renovation does not include heat resiliency components, such as shade structures or water spray features.	**No Impact** **Flood Resiliency Example:** In a low-flood-risk area, a building's mechanical systems are renovated without elevating critical equipment located in the basement. **Heat Resiliency Example:** In a low-heat-risk area, a playground renovation does not include heat resiliency components, such as shade structures or water spray features.

Figure Source: OMB

Environmental and Social Benefits

Many capital projects that the city undertakes have additional benefits beyond reducing emissions or improving climate resiliency, including benefits to health, local ecology, and air quality.

These tags have been revised to align with the EJNYC report's categorization of environmental burdens and benefits, outlined in the table below.[20] While projects are tagged using the report's categorizations, this analysis does not summarize EJ investments because it does not consider whether projects are located in EJ areas, as defined by the report.

FIGURE 11 | ENVIRONMENTAL AND SOCIAL BENEFITS

Benefit	Project Criteria *Projects that support…*	Examples
Access to Resources	• Public spaces • Natural areas • The health and ecological function ecosystems and wildlife habitats	• Parks, plazas, community gardens, playgrounds • Forests, conservation work, wetlands, Bluebelts • Biodiversity projects, erosion control, pest regulation
Access to Safe & Healthy Housing	• Access to affordable housing for New Yorkers	• The New York City Housing Authority, the New York City Department of Housing Preservation and Development
Air Quality	• Reduction of local indoor and outdoor air pollutants • Improvement to local air quality through green space and vegetation	• Electric vehicles, hybrid vehicles, micro-mobility, mass transit, appliance upgrades, heat electrification • Trees, wetlands, parks, community gardens, green infrastructure
Water Quality	• Sewers and wastewater management • Improved water quality in local and upstate waterways • Nature-based solutions	• Wastewater treatment plants, Combined Sewer Overflow management • Water supply infrastructure • Shoreline restoration, wetlands, Bluebelts, green infrastructure
Reduced Exposure to Climate Change	• Resiliency to the long-term impacts of flood risk • Resiliency to the long-term impacts of heat risk	• Neighborhood-scale coastal protection projects, floodwalls, sewer buildout, green infrastructure • Public pools, shade structures in playgrounds, tree planting, enhanced cooling in buildings
Reduced Exposure to Hazardous Materials	• Reducing exposure to outdoor hazards • Reducing exposure to indoor hazards	• Environmental testing, soil remediation, Superfund sites • Lead paint testing and removal, lead pipe testing and removal, asbestos testing and removal
Circular Economy	• Waste reduction • Beneficial reuse	• Recycling, composting, waste management • Gas-to-grid

Figure Source: OMB

** Circular Economy is not identified as a priority in EJNYC, but is tracked as a benefit in the CAA.*

CITATIONS

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The City of New York
Executive Budget
Fiscal Year 2027

Zohran Kwame Mamdani, Mayor

Mayor's Office of Management and Budget
Sherif Soliman, Director

Technical Appendix B: Resiliency Exposure Inventory and Forecast

New York City Climate Budgeting

CONTENTS

Introduction

New York City currently faces multiple climate threats, including coastal storms, intense rain events, extreme heat, drought, poor air quality, wildfire, extreme winter storms, and others. The NYC Mayor's Office of Management and Budget's (OMB) Environmental Sustainability and Resiliency Task Force conducts analysis to better understand present and future risk and investments. This document summarizes the methods surrounding this updated assessment for the Fiscal Year 2027 Executive Budget. For this analysis, OMB focuses on three threats: extreme heat, stormwater flooding (also known as rainfall or inland flooding), and coastal flooding.

Overview of Analysis

Present-Day Resiliency Exposure Inventory

OMB has created a baseline inventory of the city's existing resiliency measures based on a suite of relevant metrics, or Key Performance Indicators (KPIs). The city already publishes numerous indexed, scored, and combined data products in addition to its individual data sets. This includes vulnerability-focused data, social indices, and hazard-focused datasets. OMB's inventory focuses on *exposure* of the city's neighborhoods to heat and flooding threats. The inventory assess the city's **adaptation** to heat and flood threats, highlighting areas that have the most adaptive capacity stemming from physical resiliency measures and features and those with the most residual **exposure**. This can be combined with other existing information, such as vulnerability indices and social factors. OMB's Resiliency Exposure Inventory (in these documents often referred to as "the inventory") does not replace or conflict with existing efforts or data. This inventory seeks to measure the factors and efforts that reduce exposure (increase adaptive capacity) that would leave fewer people, areas, or assets at risk despite varying levels of vulnerability.

The inventory provides a view of the important KPIs of resiliency in each neighborhood, creating a baseline assessment of the state of the city. The inventory is updated as new data are available to assess progress, and fill information and action gaps. This work does not provide a comprehensive picture or measurement of resiliency as a whole, but focuses on design and policy strategies to evaluate exposure and adaptive measures, including but not limited to the natural (e.g., tree canopy) and built (e.g., flood barriers) environments, as well as social cohesion and community capacity.

Future-Looking Resiliency Exposure Forecast

OMB has also begun estimating how planned actions impact future exposure. OMB has taken the first steps into projecting adaptive capacity and exposure given the city's plans, actions, and projects. This will continue to be expanded upon in the future. This establishes two conditions:

- A **Control** Scenario of local heat and flood conditions using scientific estimates of temperature, sea-level, and weather events
- A set of **Planned Action** Scenarios, whereby the control conditions are overlaid with anticipated future "Planned Actions" undertaken based on city regulations, plans, and goals

The change in exposure (future worsening climate scenarios minus future exposure-reduction efforts) is calculated for decades through 2050. This has been conducted for a small, initial set of Planned Actions, with more to be added in the future.

Year-over-Year Changes and Highlights

A summary of the work conducted in the past year for this update include:

- **Data Updates**: OMB revisited its analyses and spoke with internal and external expert bodies to update data from the previous year, as available. Wherever new data on existing KPIs for the Inventory or Planned Actions for the Forecast were available, the data were updated to reflect such changes. One notable updates, incorporated into the methods below include the release of data from a new Light Detection and Ranging (LiDAR) aerial study. This allowed for the update to many of the data fields in both the Inventory and Forecast pertaining to tree canopy cover. A second notable update included the incorporate of new NPCC coastal flood maps for future decades, as per the April 2025 release of NPCC4. All updated data sources and any associated methodological changes are detailed in the following data processing sections of these methods.
- **Supplementing**: OMB has undertaken new analysis to add onto the analysis from the FY 2026 report. Notably, new analysis was conducted to add projections of cool roof surfaces to the Outdoor Heat Forecast, and a new coastal protection project was added to the Coastal Flooding Forecast.
- **Gap Filling**: The previous data processing and expert advisory consultation revealed a substantial gap in measures of social and community resiliency in the Inventory. Primarily, physical adaptation attributes were included, but this leaves out non-physical measures. To address this for the FY 2027 report, an advisory working group was put together to determine which social and community KPIs would be appropriate to include according to the rubrics, methods, and needs described in the following sections.

RESILIENCY EXPOSURE INVENTORY

OVERVIEW

The inventory provides a unified way to view levels of adaptive capacity across neighborhoods. There are many factors that contribute to a neighborhood's resiliency levels to various threats. This analysis takes a holistic view to combine and analyze datasets to compare and contrast strategies, levels of exposure and adaptation, and aid in science-based decision making. The inventory includes evaluation of outdoor heat, indoor heat, coastal flooding, and stormwater flooding separately, though strategies for addressing these hazards may overlap. Additionally, the stormwater flooding inventory analysis is considered preliminary at this time.

KPI SELECTION

KPI Research and Evaluation

OMB compiled a list of KPIs based on research and consultation according to four criteria. KPIs should not be considered exhaustive or a full picture of adaptive measures.

1. **Research support**: KPIs must represent strategies to reduce exposure with support from the academic literature or in practice from designers and engineers. Some KPIs are eliminated from consideration based on a lack of research body.
2. **Data availability**: Datasets must be broadly available for the KPIs. KPIs for which information is generally not collected or easily triangulated from available data in a standard and uniform manner are excluded from this analysis. Similarly, data that only exist privately or would not be shared reliably for analysis are excluded.
3. **Spatial and temporal reliability**: KPIs must have citywide and cyclical data. If data are only available in certain neighborhoods or without a clear recurrence interval, they are excluded from this analysis. Though the analysis described in this document is conducted at the sub-borough level, data must be comparable across the city to be used.
4. **Feasibility**: KPIs must reflect feasible adaptation strategies that could be employed in New York City. KPIs are structured to be focused on interventions that can be influenced by design and policy decisions for resiliency, but are not required to be fully within the purview of city government, as KPIs cover both the public and private sectors (e.g., all tree canopy rather than just city-owned trees, because all trees have the potential to provide resiliency benefits). However, some data are only available at the city-government level and are thus limited (e.g., tree health assessments).

More KPIs are considered than are selected for this iteration of analysis, due to data gaps. These and other potential KPIs will aid in future analysis decisions.

Social Cohesion and Community Capacity

Thematically, the inventory has focused primarily on physical indicators of resiliency. This is due to the nature of the selection criteria that must be met in order for indicators to be incorporated into the inventory. There are several social indicators of resiliency that have been explored but have not yet met the inclusion criteria. However, the fact that these social indicators do not meet the necessary criteria for inclusion at this point in time does not discount their importance in the context of understanding citywide resiliency. In order to continue to explore the possibility of incorporating social indicators of resiliency, better understand which social resiliency metrics should be included in the inventory, and address how to fill in the missing data gaps so that the data is robust enough to be included in the future, OMB partnered with a group of esteemed researchers across all sectors to develop a social indicators working group (the Working Group).

The Working Group met eight times throughout 2025, and will work together going forward, to continue this important process. The members of the group are as follows:

Social Working Group Member	Affiliation
Bernadette V. Baird-Zars	Rutgers University
Jason Beckfield	Harvard University
Gary Belkin	Columbia University
Erin Betley	American Museum of Natural History
Lindsey Campbell	USDA US Forest Service
Amelia Ding	Columbia University
Maria A. Dombrov	Columbia University
Paul Gallay	Columbia University
Nadav Gazit	American Museum of Natural History
Annel Hernandez	Columbia University
Michelle Johnson	USDA US Forest Service
Jackie Klopp	Columbia University
Andrew J. Kruczkiewicz	Columbia University
Hellas Lee	Columbia University
Johanna R. Lovecchio	Columbia University
Kytt MacManus	Columbia University
Pablo Yanez Mena	Columbia University
Mike Menser	CUNY Graduate Center
Michael Petriello	Columbia University
Ana Porzecanski	American Museum of Natural History
Madhury Ray	NYC Department of Health and Mental Hygiene
Robert Patrick Rosso	Columbia University
Victoria Sanders	NYC Environmental Justice Alliance
Jeffrey Schlegelmilch	Columbia University
Lorraine A. Schneider	NYC Preparedness & Recovery Institute
Pavithra Priyadarshini Selvakumar	Columbia University

Liv Sevcenko	CUNY Hunter College
Mitchell H. Stripling	NYC Preparedness & Recovery Institute
Erika Svendsen	USDA US Forest Service
Dana R. Thomson	Columbia University

OMB, in partnership with the Working Group, developed a list of potential social indicators of neighborhood resilience. This list of social indicators was then organized into three main thematic categories: Emergency Information, Preparedness, and Connectedness. Depending on the available information, an extensive research process summarized the background and justification of each indicator, as well as investigated all possible potential data sources. For some proposed indicators, there was insufficient data to consider, and so those indicators were removed from the proposed pool and added to the list of "Excluded KPIs for Future Consideration", to be revisited in future years pending sufficient data.

List of Indicators Excluded due to insufficient data:

Green text = Physical Indicator

Purple text = Social Indicator

Backflow valve installations	Sewer conveyance volumes	Tree biodiversity/ Taxonomy	Self-reported flood protective measures
Building design standards (e.g., LEED, Passive House)	A/C prevalence in congregate living (e.g., prisons, shelters, seniors)	Small Business Networks	Anthropogenic- & waste-heat recovery technology
Sidewalk shade structures (e.g., bus stops)	Fire hydrant water pressure/Spray caps	Housing mobility/Buyouts & Acquisitions	Infrastructure/Transit protections
Private tree health	Subgrade spaces	Rain barrels	Cooling centers
Outdoor water features	Energy burden/ Affordability/Cost	Infrastructure/Transit protections	Sewer/Catch basin maintenance
Green infrastructure volumes	Deployable flood barriers	Green infrastructure maintenance	Emergency power/Generators
A/C usage	Electric grid stability/Disruption	Low-heat-retention building materials	Elevated equipment and mechanicals
Contiguous permeable surfaces	Contiguous cool surfaces	Socially important buildings protected	Premature tree mortality
Street-level surface color	Housing energy/Cooling efficiency/Weatherization	Building shade/Ventilation	Small Business Networks
Community trust in government information	Robustness of community outreach systems	Community trust in community organizations' information	Prevalence of centralized disaster preparedness activities
Awareness of community networks	Efficacy belief in social and community groups	Vitality of social groups (how often are they providing for/interacting with the community)	Voter Registration

Figure Source: OMB

List of Proposed Social KPIs

KPI Category 1: Emergency Information

- **KPI 1a: Uptake of NotifyNYC notifications (sign ups)**
  - ☐ Background and Literature: Emergency notification systems often take a variety of forms, with complimentary systems often being utilized at the same time (e.g., government notifications vs social media). There are many reasons for heterogenous responses to the same notifications[1]. However, official emergency alerts are an important official disaster protection strategy. In a review, Sadiq et al.[2] examines the many studies on emergency notification design, uptake, and effects. Zheng et al.[3] describes that information from more 'credible' sources have a larger influence on individuals' decision making. Babvey et al.[4] describe how government warnings disseminate faster than eyewitness. However, it should be noted that Jung et al.[5] studied NYC emergency notifications and found that language barriers were substantial to notification recipients understanding the notification information.
  - ☐ Status: Cannot include – NYCEM informed that NotifyNYC data is not available with location specificity. Individuals can sign up without indicating their address (or can specify multiple addresses), meaning this dataset cannot be spatially analyzed.

- **KPI 1b: Count of organizations that notify/check on community**
  - ☐ Background and Literature: Sansom et al.[6] found that hearing emergency information from family and friends significantly improved willingness to adhere to shelter in place orders, in comparison to emergency communications radio, social media, outdoor sirens, or a government automated alert system. Collins et al. also found that those with more dependable networks choose to stay rather than evacuate—while it is unclear if this is a positive result, it reinforces the importance of social networks in decision-making and the importance of community organizations in providing preparedness and response services. Baudoin et al.[7] suggested that grassroots emergency warning systems are better than top-down for vulnerable communities to prevent exacerbating inequities. The National Household Survey, conducted by FEMA, indicated that 89 percent of people have encountered disaster preparedness information. For those who had this awareness, they were at least five times more likely to take some kind of preparedness action compared to those lacking in information. From this we understand the importance of communicating emergency info and alerts through many channels[8].
  - ☐ Status: Cannot include – insufficient data

KPI Category 2: Preparedness

- **KPI 2a: Prevalence of centralized disaster preparedness activities**
  - ☐ Background and Literature: The centralized disaster plan on a state or federal level provides a hierarchical organizing structure necessary for quick response, though it is noted that these plans should retain flexibility to be able to work with more localized networks and to remain adaptive to quickly changing conditions[9]. As disasters become increasingly common due to climate change, leaving more people living in high-risk zones, it is important for organized preparation efforts to take place to ensure response quick and efficient response times and action during any future disasters. Strong state and federal level preparedness measures, whether in the form of disaster plans or mitigation policy play a key role in minimizing harm. For example, during the 1999 Northridge Earthquake in California, it was found that 22% of the risk mitigation of local organizations and networks were based on centralized state plans and

building codes[10]. Despite the ultimate importance of a networked and localized disaster response, a centralized coordinator, such as the National Response Framework in the U.S., can help facilitate responses and provide structure and guidance to many interwoven agencies and community organizations[11].

- ☐ Status: Cannot include – data insufficient. NYCEM has information on groups and communities that undergo some of their programs, but they are not the best proxies. One is the CERT program, but it seems that all or most community districts have a plan and it is a binary yes/no. The ReadyNY program measures attendees to informational programs, but this may not be comprehensive enough a measure.

- **KPI 2b: Prevalence of community disaster preparedness and response plans**
  - ☐ Background and Literature: In addition to federal emergency and disaster management plans, community groups will often self-organize on a smaller scale to create protocols and local support. Preparedness for disasters on the community level includes increasing knowledge of disasters, how they function, and what to do when they happen, contributing to a better state of wellbeing for the community as a whole[12]. A study done on vulnerable evacuees from Hurricane Katrina highlighted the role that family and extended family had in influencing evacuation either prior to or during the storm[13]. Many expressed that there were no resources for helping overcome obstacles to evacuation such as transportation and information. The value of community-based disaster preparedness and response plans lies in the evidence that people will often be swayed to act in certain ways based on what their family, extended family, and greater community is doing and advising. Extending the "scripted actions" of federal agency disaster response into collaboration with communities gives opportunity for the addition of "emergent actions" such as spontaneous acts of community solidarity and local mutual aid, may better serve the needs of communities by creating more localized preparedness and response measures that are sensitive to the identities and structures of the community[14].
  - ☐ Status: Cannot include- data source unclear
- **KPI 2c: Count of community groups participating in preparedness efforts**
  - ☐ Background and Literature: In the event of a largescale natural disaster, FEMA recommends that individuals be prepared to survive for several days before help arrives[15]. Despite this, the 2023 FEMA National Household survey found that only 51% of people said they were prepared for a disaster to occur[16]. Ensuring that community groups are participating in disaster preparedness events and training helps address the gap in citizen preparation and addresses the lack of resources that some community groups and municipalities face[17]. Many people, especially the most vulnerable community members, may not be aware of the types of risks they are facing, but outreach within the community through familiar groups can serve as an effective bridge, not only for education but for building stronger community bonds, trust, and cohesion[18].
  - ☐ Status: Cannot include- insufficient data

- **KPI Category 3: Connectedness**
- **KPI 3a: Count of community networks/groups (all types)**
  - ☐ Background and Literature: Community networks are used in many studies as a proxy for measures of community connectedness and preparedness[19]. In fact, social circumstances (community) are one of the three pillars of sustainability as they were originally presented by Barbier in 1987[20]. As such, strong community networks, and consequently community

grounded actions are an important part of the foundation of resiliency in order to ensure a people-centered approach that meets the community's unique needs[21].

- ☐ Status: Can include utilizing data from STEW-MAP.

- **KPI 3b: Engagement with community groups (volunteers, members)**
  - ☐ Background and Literature: Social and cultural groups among communities are known to mitigate psychological stress and create a sense of belonging. Matthews et. al[22]. These benefits go far in terms of resiliency planning, as tighter knit communities are more likely to support each other financially, logistically, and emotionally. Collaborative community spaces, such as community gardens, provide a space for creating a shared sense of meaning and pride in the local area. McMillan et al.[23]. Engaging in these spaces via stewardship or volunteering is an entry point for civic engagement with the community and builds relationships among neighbors. The length of time a person spends living in an area or neighborhood also has an influence on their perception of their own safety in that area and how they feel about the others in the community. Guo et al.[24]. People who perceived their safety to be poor in the study also suffered from more anxiety and overall rated their health more poorly.
  - ☐ Status: Cannot include – not clear what the appropriate proxies are for efficacy (e.g. volunteers, staff, money) even though STEW-MAP collects this data. These may just reflect different ways of operating and not effectiveness 1:1.
- **KPI 3c: Perceived social cohesion**
  - ☐ Background and Literature: Community and friendship networks correlate with both disaster preparedness and response networks will look like[25]. Social capital, of which community cohesion and trust are a part of, can help mitigate hazard risk by creating stronger traditions and networks of mitigation behaviors[26]. Willingness to pitch in to the pool financially to help provide for more resilient infrastructure was found to be positively linked with an increased sense of social cohesion among community members in one study in a cyclone-prone area of Bangladesh[27]. It is important to note, however, that social cohesion can lead to a lower perception of risk and a stronger sense of safety, which has the potential to create a false sense of safety in a community[28].
  - ☐ Status: Cannot include – insufficient data

Of all these potential KPIs, the only one with sufficient data and literature to be included in the inventory was KPI 3a: Count of community networks/groups (all types). Supported with data from the USDA US Forest Service's STEW-MAP, this KPI provides a count of community groups operating within each NTA, providing one possible way to assess the amount of social support in a given neighborhood. However, due to the nature of the inventory, it was deemed that adding just one social indicator this year would not do justice to the way they are operationalized, therefore, KPI 3a was not included in this year's scoring process. A preliminary map has been included below, however, to display the analysis of KPI 3a thus far. As data on social resiliency becomes more available, the hope is that more of these important indicators will be able to be included in the inventory in future years.

Spatial Relationships

The hazards New York City faces and the resiliency strategies to combat them are location specific, requiring spatial analysis. Ideally, research on resiliency exposure attributes would be at the most granular level possible, the sub-block scale. Even at the micro-scale variations, such as at the level of a single city block, in elevation, infrastructure, and asset and population distribution can affect the level of exposure and resiliency. However, at this time such a granular scale is not possible for analysis due to data availability across KPIs. In the future, finer spatial data could be considered to account for these variations. Currently, the "neighborhood" level of analysis is used. Neighborhoods in this analysis are classified by Neighborhood Tabulation Areas (NTAs) 2020, mid-sized statistical geographic distinctions that aggregate census tracts, developed by the New York City Department of City Planning.[29]

NTAs are designed to be intuitive for residents, by combining areas according to commonly understood neighborhoods. However, NTAs are still an imperfect measure. Neighborhoods are a subjective classification and can change. Furthermore, because NTAs do not nest coterminously into administrative boundaries, it can be unclear the course of action, such as the local elected representative to engage on issues (e.g., assembly districts, council districts) for those who want to influence resiliency. Lastly, they do not represent natural or infrastructural boundaries, such as sewersheds, which represent natural features or infrastructure corridors that can be useful for context and intervention with actionable consequences. In future iterations, other or additional geographic boundaries, such as administrative or natural boundaries, may be considered for this analysis.

FIGURE | KPIS SELECTED FOR INVENTORY

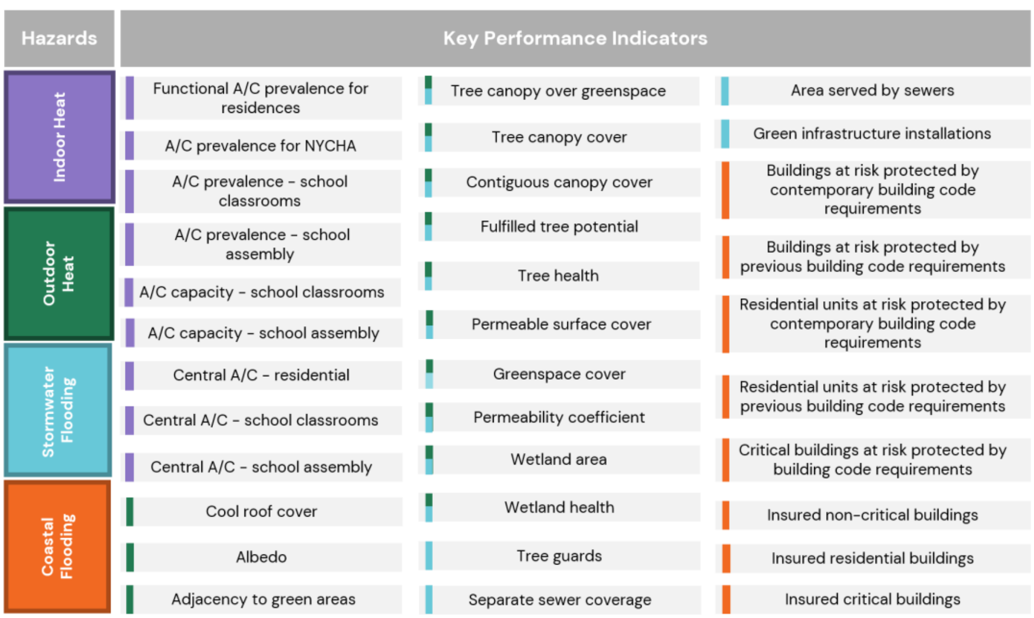

Figure Source: OMB

SCORE CREATION

In order to create neighborhood-level scores of baseline resiliency strategies, OMB developed a methodology for conducting the indexing exercise and generating scores. OMB reviewed expert literature and drew from professional experience creating indexed products to develop the steps described below. The process begins with obtaining and processing the datasets, then determining which need cleaning, and geocoding. This includes contending with idiosyncratic geospatial data, reducing risk of double counting and over- or under-weighting variables, and accurately representing scores, with transparency for underlying KPIs. The process is described in more detail in this section, from data receipt to score generation.

Data Processing Steps

FIGURE | KPI PROCESSING STEPS

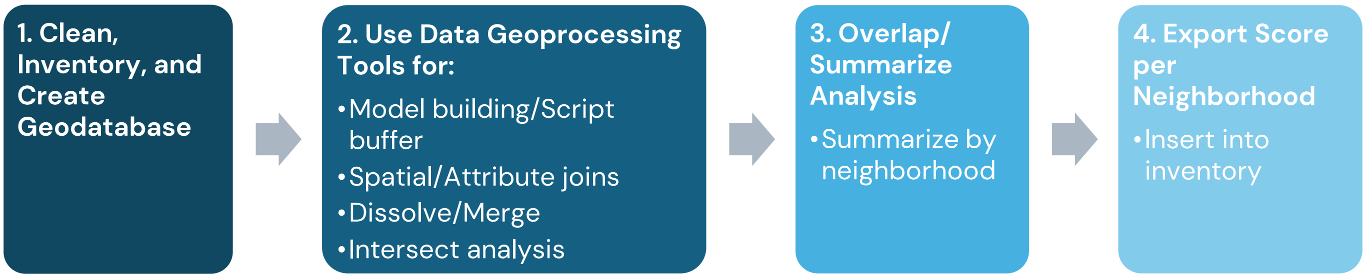

Figure Source: OMB

1. **Data cleaning and geodatabase creation:** For each KPI, data are received and prepared to be inserted into a map layer in QGIS or ArcGIS Pro. This is done either in Microsoft Excel or in Geographic Information Systems (GIS) platform directly.

2. **Data geoprocessing:** Datasets are then manipulated using a suite of geoprocessing tools available between the two GIS platforms before aggregating at the NTA level. These tools include but are not limited to: Script Building in Python for GIS, Model Building, Buffer, Intersect, Spatial and Attribute Joins, Hot-Spot Analysis, Dissolve and Merge, Union, and Overlap Analysis.

3. **Overlap and summary tools:** Once geoprocessing is complete, data are processed using the Overlap Analysis tool in QGIS or the Summarize Within tool in ArcGIS Pro to calculate percent area or points within each NTA. As described in more detail in subsequent sections, all values in the inventory are calculated as proportions (e.g., area of tree canopy per total neighborhood area). This processing step calculates those proportions. This is important to be able to compare NTAs. As they have different sizes, densities, and contexts.

4. **Neighborhood-level exports:** Scores are then exported to tabular form and inserted into the Microsoft Excel inventory model.

Scoring Process

Organizing and Processing Scores: Indicators Level

KPI Hierarchy

Each KPI is organized into an Indicator Category, which represents the overall strategy the KPIs within take to reduce the hazard itself or the impact of the hazard. In the model, KPIs are differentiated by Type. Before KPIs are combined into Categories, some KPIs get merged together first because they are highly related. These KPIs that get merged are labeled as Primary Indicators and Modifying Indicators. Primary Indicators represent the independent variable that is correlated with subordinate Modifier variables (e.g., tree canopy cover would be a Primary Variable to be Modified with tree canopy over greenspace). Modifier variables are considered subordinate because they can highlight nuances in the Primary variable, such as in distribution or co-benefits, but are ultimately a measure derived from the Primary variable with slight variations that make their relationships unique. Once a variable is ready to be combined into Categories, either because it is a stand-alone KPI or because several Primary and Modifier KPIs have been merged together, the resulting variable is referred to as a Final Indicator.

Treating Correlated and Related Variables

Modifiers represent small “boosts” to the Primary Indicator value in calculation. Rather than averaging the variables and undermining the raw value of the Primary Indicator, 10 percent of the value of the Modifier(s) is added on top of the Primary Indicator score. Selecting 10 percent stems from the desire to balance the low relative value of the modifier, as ancillary to the Primary Indicator, while still including these correlated variables in the model because of their importance for parsing sub-strategies for adaptation. Modifiers shed more light on the application of strategies, but 10 percent is not a perfect estimation of their relative importance. Modifiers at 10 percent balance are used to serve as a middle ground between choosing an overly simplistic parsimonious model and removing correlates to prevent double counting.

On Correlation**:** Each KPI’s NTA-level data is assessed using Pearson’s Correlation analysis. To avoid redundancy, closely correlated KPIs are aggregated. Each KPI (proportions) is compared to every other KPI to determine their correlation. Correlation Coefficients (R values) >0.7 or <-0.7 are individually considered to determine if removal or Primary-Modifier aggregation is more appropriate. A full showcase of the correlation analysis for each indicator is available in the FY26 Publication Technical Appendices.

FIGURE | KPI PAIRS WITH HIGH CORRELATION

Variable 1	Variable 2	R	Determination
Tree canopy cover	Contiguous canopy cover	0.8045	Combined into "Tree Canopy" Final Indicator, with Variable 1 as primary and Variable 2 as modifiers
Tree canopy cover	Tree canopy over greenspace	0.8985	
Tree canopy cover	Greenspace cover	0.7634	N/A because separate Categories
Tree canopy over greenspace	Permeable surface cover	0.8532	N/A because separate Categories
Tree canopy over greenspace	Greenspace cover	0.8886	
Tree canopy over greenspace	Permeability coefficient	0.7210	
Permeable surface cover	Greenspace cover	0.9789	Combined into "Permeable Surfaces" Final Indicator, with Variable 1 as primary and Variable 2 as modifiers
Permeable surface cover	Permeability coefficient	0.8567	Combined into "Permeable Surfaces" Final Indicator, with 'Permeable surface cover' as primary and others as modifiers
Greenspace cover	Permeability coefficient	0.8349	
Central A/C – school assembly	A/C prevalence – school assembly	0.7806	Combined into "A/C – school assembly" Final Indicator, with A/C prevalence as primary and others as modifiers
A/C capacity – school assembly	A/C prevalence – school assembly	0.9068	
A/C capacity – school assembly	Central A/C – school assembly	0.7116	
Central A/C – school assembly	Central A/C – school classrooms	0.7108	N/A because Central A/C – school assembly already combined with others
Insured non-critical buildings	Insured residential buildings	0.7399	*N/A at this time because in future will measure residential units when data available (rather than measuring buildings)*

Figure Source: OMB

It is important to note that correlation does not represent causality or a physical relationship between variables. At this time, many of the correlated variables share physical bases, such as permeable surface cover and greenspace and tree canopy cover and greenspace. These are physically related and likely explain at least some of the relationship. However, other KPIs could be correlated and not share underlying physicality.

1. **Relatedness:** In addition to highly correlated variables being grouped by primary and modifying KPIs, two additional variables are included as modifiers due to relatedness despite low Pearson's correlation.

a. *A/C prevalence for NYCHA*. This KPI includes data from surveyed NYCHA residents on their A/C. The larger-scale *functional A/C prevalence for residences* KPI already represents information on A/C across housing types for the city through a different survey. Because NYCHA residents are a subset of residents in the larger survey, which is less comprehensive for NYCHA residents because it entails a broader population view, NYCHA residents are included as a separate KPI because of their unique attributes and types of A/C policies. These are thus not highly correlated but one is a subset of the other and they are combined as Primary and Modifying Indicators.

b. *Adjacency to green areas*. This KPI aims to cover a gap in evaluation of permeable surfaces. Parks and large, green, open spaces such as cemeteries provide value in their ability to manage heat (they often also have sizable tree canopy cover). Some of these spaces are included in NTAs, while others are so sizable they receive their own NTA, such as Central Park or Green-Wood Cemetery. Despite their benefits, these NTAs are difficult to include in indexes such as this because these NTAs are incomparable with other areas, such as residential neighborhoods. Rather than leaving them out of analysis entirely, Core NTAs are evaluated for their adjacency (the proportion of their area that contacts an Adjacency NTA) to large greenspace that is not already included in an NTA, and this proportion is used as its own KPI. This is not highly correlated with other measures, but is a Modifier because of its quality as a "booster" rather than a typical KPI.

FIGURE | ALL INDICATORS

Hazard	Indicator Category	Indicator	Indicator Type
Outdoor Heat	Outdoor heat managed by trees	Tree canopy cover	Primary
		Contiguous canopy cover	Modifier
		Tree canopy over greenspace	Modifier
		Tree canopy	Final
		Fulfilled tree potential	Final
		Tree health	Final
	Outdoor heat managed by permeable surfaces	Permeable surface cover	Primary
		Greenspace cover	Modifier
		Permeability coefficient	Modifier
		Adjacency to green areas	Modifier
		Permeable surfaces	Final
	Outdoor heat managed by light-colored surfaces	Cool roof cover	Final
		Albedo	Final
	Outdoor heat managed by wetlands	Wetland area	Final
		Wetland health	Final
Indoor Heat	Indoor heat managed by residential A/C	Functional A/C prevalence for residences	Primary
		A/C prevalence for NYCHA	Modifier
		A/C prevalence – residential	Final

		Central A/C – residential	Final
	Indoor heat managed by school A/C	A/C prevalence – school classrooms	Final
		Central A/C – school classrooms	Final
		A/C capacity – school classrooms	Final
		A/C prevalence – school assembly	Primary
		Central A/C – school assembly	Modifier
		A/C capacity – school assembly	Modifier
		A/C – school assembly	Final
Coastal Flooding	Area physically protected – non-critical buildings	Buildings at risk protected by previous building code requirements	Final
		Buildings at risk protected by contemporary building code requirements	Final
		Buildings at risk protected by coastal measures*	Final
	Area physically protected – residential	Residential units at risk protected by previous building code requirements	Final
		Residential units at risk protected by contemporary building code requirements	Final
		Residential units at risk protected by coastal measures*	Final
	Area physically protected – critical buildings	Critical buildings at risk protected by building code requirements	Final
		Critical buildings at risk protected by coastal measures*	Final
	Area financially protected	Insured non-critical buildings	Final
		Insured residential buildings	Final
		Insured critical buildings	Final
Stormwater Flooding	Water managed by trees	Tree canopy cover	Primary
		Tree canopy over greenspace	Modifier
		Tree canopy	Final
		Fulfilled tree potential	Final
		Tree health	Final
		Tree guards	Final
	Water managed by permeable surfaces	Permeable surface cover	Primary
		Greenspace cover	Modifier
		Permeability coefficient	Modifier
		Permeable surfaces	Final
	Water managed by green infrastructure	Green infrastructure installations	Final
	Water managed by wetlands	Wetland area	Final
		Wetland health	Final
	Water managed by sewer coverage	Area served by sewers	Final
		Separate sewer coverage	Final

Figure Source: OMB

**Stormwater KPIs are preliminary, as they do not yet include sewer capacity at this time. KPIs in the table above with background color are grouped together whereby the Final Indicator results from a combination of Primary and Modifier Indicators, rather* *than being a standalone Final Indicator. Note that more detail of these KPIs can be found in section "Indicators" later in this document.*

Indicator Weighting

Final Indicators are normalized, weighted, and combined to create Indicator Category-level scores. Then category scores are normalized, weighted, and scored to create hazard-level scores. See the upcoming sections for more details.

Weights are assigned to KPIs and categories according to the following weighting rubric. Weightings may be subjective. They approximate the relative importance of variables in explaining exposure to heat and flooding based on an assessment of the literature and consultations with experts.

FIGURE | WEIGHTING RUBRIC

High (3)	An abundance of literature or expert knowledge supports that this variable is a crucial strategy toward reducing hazard exposure when applied.
Medium (2)	The literature or expert knowledge supports that this variable reduces hazard exposure, but the relationship may be less strong than other factors.
Low (1)	This variable relates to the reduction of hazard exposure, but outcomes may depend highly on context and is weaker than other factors.

Figure Source: OMB

For the first step of weighting, weighting decisions per Final Indicator are found below. Note that weights are only relevant within Indicator Categories. For example, a score of three for *Tree canopy* should not be directly compared to a score of two for *Wetland area*. These scores only matter in their relativity within categories and represent relative support for their importance in the literature. When a category only has one Final Indicator within, it is automatically given a three.

FIGURE | WITHIN-CATEGORY WEIGHTING

Category	Normalized Final Indicators	Weight (1-3)
Outdoor heat managed by trees	Tree canopy	3
	Fulfilled tree potential	1
	Tree health	1
Outdoor heat managed by permeable surfaces	Permeable surfaces	3
Outdoor heat managed by light-colored surfaces	Cool roof cover	3
	Albedo	3
Outdoor heat managed by wetlands	Wetland area	2
	Wetland health	1
Indoor heat managed by residential A/C	A/C prevalence – residential	3
	Central A/C – residential	1
Indoor heat managed by school A/C	A/C prevalence – school classrooms	2
	Central A/C – school classrooms	1
	A/C capacity – school classrooms	1

	A/C – school assembly	2
Area physically protected – non-critical buildings	Buildings at risk protected by previous building code requirements	1
	Buildings at risk protected by contemporary building code requirements	3
	Buildings at risk protected by coastal measures*	2
Area physically protected – residential	Residential units at risk protected by previous building code requirements	1
	Residential units at risk protected by contemporary building code requirements	3
	Residential units at risk protected by coastal measures*	2
Area physically protected – critical buildings	Critical buildings at risk protected by building code requirements	3
	Critical buildings at risk protected by coastal measures*	2
Area financially protected	Insured non-critical buildings	3
	Insured residential buildings	3
	Insured critical buildings	3
Water managed by trees	Tree canopy	3
	Fulfilled tree potential	1
	Tree health	1
	Tree guards	1
Water managed by permeable surfaces	Permeable surfaces	3
Water managed by green infrastructure	Green infrastructure installations	3
Water managed by wetlands	Wetland area	3
	Wetland health	1
Water managed by sewer coverage	Area served by sewers	3
	Separate sewer coverage	1

Figure Source: OMB

**Green text represents KPIs for outdoor heat, purple for indoor heat, orange for coastal flooding, and blue for stormwater flooding. See previous pages for description of protections by “coastal measures.”*

Weighting reasoning for Final Indicators can be found in the FY26 Climate Budgeting Technical Appendices.

Organizing and Processing Scores: Category Level

After weighing Final Indicators, scores for each category are generated and categories are then weighed. These compare scores across Categories and should not be compared to the relative weightings of underlying KPIs from the table above, or across hazards. The reasoning and formulation of category weightings is the same as the previously described Indicator Weightings. See the next section for more details.

Organizing and Processing Scores: Overall Scores

To combine KPIs within an Indicator Category into scores, Final Indicators are normalized using a min-max normalization. The geometric mean is used to reduce the impact of outliers and changes in score relativity over time. One is added to each Normalized Final Indicator score in the formula for the calculation of the category scores as to avoid zeros in the range, as they disrupt calculating the geometric mean.

Once NTA-level category scores are created from underlying KPIs, these category scores are normalized to create Normalized Category scores, using min-max normalization.

These are then combined using the same process for the weighted geometric mean as described above to create ultimate hazard-level scores. Hazard scores are normalized to achieve a range from 0-100 percent relative scores.

To create overall total scores across hazards, a simple average (arithmetic mean) is used and all hazards considered equally important (no weighting applied).

Note that when KPIs are not relevant (e.g., a non-coastal NTA when calculating the coastal flooding hazard-level score; an NTA without any school buildings for *A/C Prevalence – Classrooms* KPI), these are left out of calculations (as n/a rather than zero). The same formulas as above apply, but they will be calculated without the irrelevant KPI or skip the irrelevant NTA. See the previous section for the list of NTAs and KPIs for which this applies.

Summarization

Data are then summarized in Microsoft Excel. Comparing neighborhoods, higher scores refer to more adaptation work being conducted and thus less remaining exposure to threats. Higher scores mean neighborhoods are more protected, though there may be other features that mediate overall levels of risk, such as relative vulnerability. These can be combined or overlaid with these scores but are not included in these measures that focus on levels of exposure. Scores of 100 percent (the highest score) do not represent perfect or "full" resiliency. Rather they represent locations that contain relatively large coverage of resiliency design strategies included as KPIs. These neighborhoods may lack resiliency in many ways and have different absolute values of adaptation measures than other neighborhoods. Scores are relative to each neighborhood (due to using proportions within the NTA) and across neighborhoods (due to scores being normalized compared to peers.

Sensitivity Analysis

A sensitivity analysis is conducted to evaluate how sensitive the resultant final scores are to various weighting schemes. Four different options are evaluated:

1. Default: low=1, middle=2, high=3
2. Wide Spread: low=1, middle=3, high=5
3. Narrow Spread: low=.75, middle=1, high=1.5
4. Binary: low=1, high=2
5. None: all=1

For more information on this analysis, please refer to the FY26 Climate Budgeting Publication Technical Appendices.

MODIFIED INDICATORS

This section describes the KPIs used in the inventory. Lowest-level, standalone KPIs are described here: Primary Indicators and Modifier Indicators, as well as Final Indicators that are not comprised of other Primary/Modifier Indicators. KPIs are separated by their Indicator Categories and hazards and include the justification, analytical details, assumptions, data sources, update logs, and other pertinent details related to the inclusion of each KPI in the inventory.

OUTDOOR HEAT EXPOSURE KPIS

Category 1 – Outdoor Heat Managed by Trees

Indicator 1 (Primary Indicator) – Tree canopy cover

Description: Proportion of land surface (aerial) overlapped by tree crowns
Processing:

- Source: NYC Open Data Land Cover Raster—6inch Resolution[30]
- Most Recent Data Update: 2022
- Assumptions: This includes canopy on public and private property—while these trees may provide different benefits or be managed differently, they both provide cooling benefits in their own domains. Source data assume vegetation 8-feet tall is tree canopy and 8-feet tall is grass/shrub; Data is determined using aerial imagery, not on-the-ground surveys.
- Notes: Future data updates will be conducted every five years as per LL148 of 2023.[31] Tree canopy as a measure includes overhang of tree leaves, whereas the permeable surfaces describe the ground, which include tree-planted areas and vegetative cover.
- Final Indicator: *Tree canopy cover* is combined with two other KPIs—*contiguous canopy* and *tree canopy over greenspace*—to comprise the "tree canopy" Final Indicator.

Indicator 2 (Modifier) – Contiguous canopy

Description: Proportion of tree canopy cover on the sidewalk (right-of-way) that is continuous in distribution (touching)
Processing:

- Source: NYC Open Data Land Cover Raster Data—6inch Resolution[32] and NYC Open Data Planimetric Sidewalk Database[33]
- Most Recent Data Update: 2022
- Assumptions: Source canopy data assumes vegetation greater than 8 feet is tree canopy and less than 8 feet is grass/shrub; Data determined using aerial imagery, not on-the-ground

surveys. For sidewalks, areas under construction/protected from scaffolds are collected along an imaginary line to complete the right-of-way (ROW) polygon. The scaffolded areas would be shaded and thus cooler, but not captured in this analysis as they are not shaded by tree canopy. While contiguity may play a role in cooling non-ROW spaces, ROW is selected here to account for locations where individuals will be impacted by shade continuously, though this is an imperfect measure for locations that affect pedestrians and others outdoors.

- Notes: To create the count of right-of-way segments of sidewalk are shaded by contiguous canopy, the sidewalk polygons are split into equal area breaks of 450 feet^2. This area is chosen to resemble the distance between individual street trees. Then, canopy coverage is clipped to the ROW breaks. Canopy overlapping ROW breaks are then extracted if they are adjacent other breaks with canopy coverage, and thus contiguous. The extracted count is compared to the total number of breaks per NTA.
- Final Indicator: *Canopy contiguity* is combined with two other KPIs—*tree canopy cover* and *tree canopy over greenspace*—to comprise the *tree canopy* Final Indicator.

Indicator 3 (Modifier) – Tree canopy over greenspace

Description: Proportion of tree canopy that overlaps with vegetated area
Processing:

- Source: NYC Open Data Land Cover Raster Data—6inch Resolution[34] and NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[35]
- Most Recent Data Update: 2022
- Assumptions: Source canopy data assumes vegetation greater than 8 feet is tree canopy and less than 8 feet is grass/shrub; Green space area determined using aerial imagery, not on-the-ground surveys. Classification of green spaces are "grass/bush", per DEP.
- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Datasets are based on the same LiDAR flyover period, so areas adjacent are defined by using the "Select by Location" tool. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Tree canopy over greenspace* is combined with two other KPIs—*tree canopy cover* and *contiguous canopy*—to comprise the *tree canopy* Final Indicator.

Indicator 4 (Final Indicator) – Fulfilled tree potential

Description: Proportion of potential tree canopy growth area that has existing canopy
Processing:

- Source: Practical Canopy for New York City;[36] Understanding Opportunities for Urban Forest Expansion to Inform Goals: Working Toward a Virtuous Cycle in New York City;[37] NYC Open Data Parks and Recreation Forestry Tree Points,[38] NYC Open Data Building Footprints;[39] NYC Open Data Land Cover Raster Data—6inch Resolution[40]
- Most Recent Data Update: 2022

- Assumptions: A buffer around each Forestry Tree Point is selected as 4.11 meters in radius (8.22 meter diameter of canopy per tree), which was calculated by Treglia et al. (2022) using the average diameter of trees owned by the NYC Parks Department for the most common ten species.[41] This included tree planting spaces in the right-of-way that do not have live trees in them (such as exclusively empty tree beds, listed as "PSStatus = Empty", only) This count does not include other variations of tree beds that are potentially empty intentionally, such as "Retired", "Retired-Do Not Plant" or "Empty-Do Not Plant". Hypothetical canopy extents are then clipped by building areas according to the city's Building Footprints dataset provided by the NYC Department of Technology and Innovation. This achieves a "potential" canopy value for street trees. Some street trees' aerial canopy cover extents already cover some or all of the potential area, which would be classified as the fulfilled area. Existing trees may go beyond the hypothetical extents in real cases, such as for mature trees, and these overhangs is not considered in the ratio—these are additional canopy areas beyond the "potential" extents.
- Notes: Some data, such as tree planting spots, are updated frequently but the update date of this overall KPI is considered to be 2022 due to that being the most recent update of the LiDAR Raster survey.

Indicator 5 (Final Indicator) – Tree health

Description: Street trees' conditions as assessed by the New York City Parks Department (proportion of street trees with Fair, Good, or Excellent health)
Processing:
- Source: NYC Open Data Parks and Recreation Forestry Tree Points[42]
- Most Recent Data Update: 2025
- Assumptions: Trees are selected as being "healthy" if they are rated by the NYC Parks Department as Fair, Good, or Excellent. The proportion of street trees included all categories of tree condition (Excellent, Good, Fair, Poor, Critical, Dead, Unknown). The canopy area of trees that met the criteria listed above, by point, are extracted from the possible tree point classifications and the resulting "healthy canopy area" of the resulting points are translated per neighborhood.
- Notes: None

Category 2 – Outdoor Heat Managed by Permeable Surfaces

Indicator 1 (Primary Indicator) – Permeable surface cover

Description: Proportion of surfaces that allow for water infiltration
Processing:
- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[43]
- Most Recent Data Update: 2020
- Assumptions: This includes what DEP considers in analysis to be both "semi-pervious" and "pervious," which includes the land cover classes: gravel, synthetic turf, bare soil, sand, grass,

bush, and tree.[44] Permeable surfaces here do not likely include engineered porous pavements, as these would likely present in a LiDAR analysis as asphalt or concrete. These specialty pavements (a type of green-grey infrastructure), though porous, are not added into this analysis in any way, as they show varying effects on heat abatement depending on dry or wet conditions.[45] Trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features as in the *Outdoor Heat Managed by Trees* Indicator Category described above.

- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Permeable surface cover* is combined with three other KPIs—*greenspace cover*, *permeability coefficient*, and *adjacency to green areas*—to comprise the *permeable surfaces* Final Indicator.

Indicator 2 (Modifier) – Greenspace cover

Description: Proportion of surface area covered by vegetation
Processing:

- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[46]
- Most Recent Data Update: 2020
- Assumptions: This includes what DEP considers in analysis to be grass, bush, and tree.[47] Trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features of canopy as in the *Outdoor Heat Managed by Trees* Indicator Category described above.
- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Greenspace cover* is combined with three other KPIs—*permeable surface cover*, *permeability coefficient*, and *adjacency to green areas*—to comprise the *permeable surfaces* Final Indicator.

Indicator 3 (Modifier) – Permeability coefficient

Description: Weighted average of permeabilities associated with substrate type
Processing:

- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[48]
- Most Recent Data Update: 2020
- Assumptions: Permeability coefficients are averages and are typically assigned ranges for different substrate types. The average may or may not accurately reflect the permeability in practice, including if it is clogged or compacted. Weighted averages of the average permeabilities for substrate types by area for each NTA are taken. This includes what DEP considers in analysis to be both "semi-pervious" and "pervious," which includes the land cover

classes: gravel, synthetic turf, bare soil, sand, grass, bush, and tree.[49] Trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features as in the *Outdoor Heat Managed by Trees* Indicator Category described above.
- Notes: Permeable surfaces do not likely include engineered porous pavements, as these would likely present in a LiDAR analysis as asphalt or concrete. These specialty pavements (a type of green-grey infrastructure), though porous are not added into this analysis in any way, as they show varying effects on heat abatement depending on dry or wet conditions.[50]
- Final Indicator: *Permeability coefficient* is combined with three other KPIs—*permeable surface cover*, *greenspace cover*, and *adjacency to green areas*—to comprise the *permeable surfaces* Final Indicator.

Indicator 4 (Modifier) – Adjacency to green areas

Description: Proportion of neighborhood area bordering NTA-sized greenspace, parks and cemeteries.
Processing:
- Source: NYC Open Data 2020 Neighborhood Tabulation Areas (NTAs)[51]
- Most Recent Data Update: 2025
- Assumptions: Large parks and greenspaces are selected manually based on the name of the NTA or known attribute of the area (e.g., Central Park). Cemeteries are included in this evaluation as they contribute to large urban green features. This list includes what the NYC Parks Department considers to be a non-residential park or cemetery (see the preceding sections of these methods for which KPIs are included in this list).
- Notes: Buffer zones of 100 feet are added to the boundaries of each large "green" NTA to strengthen the quality and accuracy of the analysis, and to ensure all neighboring residential NTAs are added to the Final Indicator. The proportion of overlap with Core NTAs is calculated for each of the Core NTAs and this used as a measure of adjacency to one or more large-scale greenspaces otherwise not captured by another Core NTA, attributed to those Core NTAs.
- Final Indicator: *Adjacency to green areas* is combined with three other KPIs—*permeable surfaces, greenspace cover*, and *permeability coefficient*—to comprise the *permeable surfaces* Final Indicator.

Category 3 – Outdoor Heat Managed by Light-Colored Surfaces

Indicator 1 (Final Indicator) – Cool roof cover

Description: Proportion of building roofs with high solar reflectance (light color)
Processing:
- Source: NYC Open Data Building Footprints;[52] Dr. Mehdi Heris, Hunter College
- Most Recent Data Update: 2025
- Assumptions: There is no one standard for "high" albedo. A value of 0.6 is used as the threshold for high albedo in this study, as advised by researchers conducting heat resiliency work in New

York City. However, other values could be suitable, with common values between 0.5 and 0.9.[53.] Note that some green roofs may be double counted between this Indicator and the permeable surfaces Indicator. These are derived from different source datasets and for different Indicator Categories. Light-colored roofs mostly apply to synthetic surfaces with colors such as white and cooling benefits are derived from high reflectance of light, whereas the cooling benefits of permeable surfaces and vegetation are from shade and evapotranspiration. Cool roofs may include some green roofs, as green roofs often have a higher albedo than traditional roof cover, despite having lower albedo than white or other "cool roofs." Green roofs are checked against maps of the city's green roof spaces by Treglia et al. (2022) and NYC DEP to check that most green roofs are being included in the "outdoor heat managed by greenspace" Indicator Category, but will not be included fully in the Light-Colored Roofs or Albedo Indicators.[54] Roof spaces only are assessed. While ground-level surface albedo may impact urban heat, the effects are less established, with some studies showing that despite overall temperature reductions, pedestrian 'felt-heat' is greater.[55] Unlike for roofs, there is no public city strategy to change the color of dark-colored ground-level spaces such as roadways and the implications would need to be assessed before deciding to include.

- Notes: Large rooftop items such as electrical equipment may interfere with the calculation of solar reflectance. To account for this, the reflectivity of at least 65 percent rooftop cover is used to generalize the status of the roof surface. Other impacts, such as steeply sloped roofs (e.g., skyscrapers) are harder to accurately assess using the current methodology. Rooftops with solar panels covering 65 percent of rooftop cover or less are assessed for their background albedo. Rooftops above this threshold are read for their solar panel albedo, though these systems may be warmer than a cool roof given their heat absorption for energy conversion. These are not a large proportion of rooftop spaces, though may represent a complex case.

Indicator 2 (Final Indicator) – Albedo

Description: Weighted average surface albedo (by area) for roofs
Processing:

- Source: NYC Open Data Building Footprints;[56] Dr. Mehdi Heris, Hunter College
- Most Recent Data Update: 2025
- Assumptions: Roof spaces only are assessed. While ground-level surface albedo may impact urban heat, the effects are less established, with some studies showing that despite overall temperature reductions, pedestrian 'felt-heat' is greater.[57] Furthermore, unlike for roofs there is no public city strategy to change the color of dark-colored ground-level spaces such as roadways and the implications would need to be assessed before deciding to include.
- Notes: Large rooftop items such as electrical equipment may interfere with the calculation of solar reflectance. To account for this, the reflectivity of at least 65 percent rooftop cover is used to generalize the status of the roof surface. Other impacts, such as steeply sloped roofs (e.g., skyscrapers) are harder to accurately assess using the current methodology. Rooftops with solar panels covering 65 percent of rooftop cover or less are assessed for their

background albedo. Rooftops above this threshold are read for their solar panel albedo, though these systems may be warmer than a cool roof given their heat absorption for energy conversion. These are not a large proportion of rooftop spaces, though may represent a complex case.

Category 4 – Outdoor Heat Managed by Wetlands

Indicator 1 (Final Indicator) – Wetland area

Description: Proportion of land cover that is natural wetland area
Processing:

- Source: NYC Open Data Wetlands Map;[58] U.S. Geological Survey Wetlands Mapper[59]
- Most Recent Data Update: 2026
- Assumptions: Note that this does not necessarily include engineered spaces such as green infrastructure bluebelts,[60] but may incorporate these features where they are built into existing wetland areas. Double counting may occur between cover and forested wetland area for forested wetlands, though it is clear that wetlands take unforested forms and may provide benefits separate from the canopy benefits alone. Furthermore, double counting may occur between this Indicator and permeable surfaces/greenspace, but wetlands provide more substantial benefits compared to other vegetated spaces. This Indicator does not include water-estuaries or riverine areas within its area calculation.
- Notes: Wetlands are included if they are included in the NYC Parks Department's wetland inventory, as well as the NY State and U.S. Federal wetlands delineations. The NYC Parks Department's wetlands were mapped using remote sensing analysis in conjunction with the University of Vermont. The NYC Parks Department has verified and updated this through an assessment with the Natural Areas Conservancy on the ground.

Indicator 2 (Final Indicator) – Wetland health

Description: Percent of wetland area that is classified as Healthy, Threatened, or In Transition
Processing:

- Source: NYC Nature Map;[61] Natural Areas Conservancy; U.S. Geological Survey Wetlands Mapper[62]
- Most Recent Data Update: 2026Assumptions: Only city-owned wetland property is assessed, though much wetland space may be privately owned. Only "degraded" as a classification is not included in the determination of wetlands as constitutes appropriate health, as this represents wetlands where substantial restoration is needed. The health assessment is conducted by the NYC Parks Department and Natural Areas Conservancy according to rubrics for salt marshes, freshwater wetlands, and streams outlined in the 2021 Wetlands Management Framework and for forested wetlands outlined in the 2018 Forest Management Framework.[63]
- Notes: None

INDOOR HEAT EXPOSURE KPIS

Category 5 – Indoor Heat Managed by Residential A/C

Indicator 1 (Primary Indicator) – Functional A/C prevalence for residences

Description: Proportion of households (general population) who have A/C
Processing:

- Source: New York City Housing and Vacancy Survey 2023;[64] NYC Department of Housing Preservation and Development
- Most Recent Data Update: 2023
- Assumptions: Data are self-reported via survey and may contain sampling error, which is unavoidable in survey research. In the Housing and Vacancy Survey, data on window/wall A/Cs are combined with non-responsive participant data, which introduces potential overcounting of A/C prevalence. Data are aggregated at the smallest geography that ensures protection against data disclosure, the Public Use Microdata Area (PUMA). Because NTAs are smaller than PUMAs, for the purposes of this NTA-level analysis, the proportions for each PUMA are applied to all constituent NTAs, which may not be accurate. This translation was conducted using the Department of City Planning's resources on PUMA geographic relationships to equivalent Community District Tabulation Area for 2020 and subsequently translated to NTA 2020 boundaries using the second crosswalk provided in the 2020 Census Reconfiguration of Statistical Geographies tool.[65]
- Notes: Disclaimer regarding source data at PUMA level—The Census Bureau has reviewed this data product for unauthorized disclosure of confidential information and has approved the disclosure limitation practices applied. (Approval ID: CBDRB FY24 0145). Note that data includes various types of housing, including that owned and operated by the New York City Housing Authority (NYCHA), financed by the New York City Department of Housing Preservation and Development (HPD), and others.[66] According to the city's initial findings from the 2023 HVS representative sample, approximately 7 percent of rental units surveyed were public housing.[67] Note that this is a measure of prevalence and energy reliability or affordability.
- Final Indicator: *Functional A/C prevalence for residences* is combined with one other Indicator—*A/C prevalence for NYCHA fee residents*—to comprise the *central A/C – residential* Final Indicator.

Indicator 2 (Modifier) – A/C prevalence for NYCHA fee residents

Description: Proportion of NYCHA units that pay a set A/C fee who have an A/C
Processing:

- Source: New York City Housing Authority
- Most Recent Data Update: 2025
- Assumptions: This includes developments surveyed by NYCHA—surveyed units mostly include those where NYCHA residents do not pay their own utility costs (they pay a set fee to NYCHA

for the presence of the air conditioner) and for buildings that are owned/managed by NYCHA—there are limited exceptions to these rules where survey data are available. Not every NYCHA housing development is included in the AC survey. Note that to these conditions there are four exceptions for properties where NYCHA informed that the property received either central A/C or all residents received wall units. These properties are considered to have 100 percent A/C in this analysis. Self-reported A/C values represent underestimations (which may differ in severity by building) because they are collected via self-reported surveys and those with unregistered A/Cs are unlikely to report having them. Validation has been conducted at select properties and these have shown more A/C units to be installed than reported—however, because validation data focuses on the number of air conditioners and not units and because it was only conducted in a few cases, this is not included in analysis here. This analysis only measures the number of units that have A/C, not the number of A/Cs per housing unit or the effectiveness/functioning of the A/C.

- Notes: Note that not every NTA has an evaluation for this KPI—some NTAs don't have a NYCHA development or one that is part of the Air Conditioning survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. NYCHA developments are characterized and geolocated according to their Tenant Data System (TDS) number as per the 2025 NYCHA Development Data Book.[68] TDS numbers were changed entirely for each development between last year's survey and this year's survey. It is unclear if the reassigning of TDS numbers is something that happens every year, but regardless great care should be taken to ensure TDS numbers for each development are updated manually before beginning analysis. This is crucial to ensure the data aligns correctly. Note that these attributes are retrieved for 2025, though the survey is conducted in 2024 and development attributes can change over time. Approximately two-thirds of developments are surveyed, which includes those that pay their own utilities or are managed by other entities, such as through the Permanent Affordability Commitment Together (PACT)/Rental Assistance Demonstration (RAD) initiative.[69] Note that the previous Indicator Functional A/C Prevalence for Residences includes NYCHA facilities, but this represents a relatedly small proportion (under 10 percent) of renters surveyed.
- Final Indicator: *A/C prevalence for NYCHA fee residents* is combined with one other Indicator —*functional A/C prevalence for residences*—to comprise the *central A/C – residential* Final Indicator.

Indicator 3 (Final Indicator) – Central A/C – residential

Description: Percent of households (general population) that have central A/C
Processing:

- Source: New York City Housing and Vacancy Survey 2023;[70] NYC Department of Housing Preservation and Development
- Most Recent Data Update: 2023
- Assumptions: Data are self-reported via survey and may contain sampling error, which is unavoidable in survey research. Data are aggregated at the smallest geography that ensures

protection against data disclosure, the Public Use Microdata Area (PUMA). Because NTAs are smaller than PUMAs, for the purposes of this NTA-level analysis, the proportions for each PUMA are applied to all constituent NTAs, which may not be accurate. This translation is conducted using the Department of City Planning's resources on PUMA geographic relationships to equivalent Community District Tabulation Area for 2020 and subsequently translated to NTA 2020 boundaries using the second crosswalk provided in the 2020 Census Reconfiguration of Statistical Geographies tool.[71]

- Notes: Disclaimer regarding source data at Public Use Microdata Area (PUMA) level—The Census Bureau has reviewed this data product for unauthorized disclosure of confidential information and has approved the disclosure limitation practices applied. (Approval ID: CBDRB FY24 0145). Note that data includes various types of housing, including that owned and operated by the New York City Housing Authority (NYCHA), financed by the New York City Department of Housing Preservation and Development (HPD), and others.[72] According to the city's initial findings from the 2023 HVS representative sample, approximately 7 percent of rental units surveyed are public housing.[73]

Category 6 – Indoor Heat Managed by School A/C

Indicator 1 (Final Indicator) – A/C prevalence – school classrooms

Description: Proportion of school instructional, traditional rooms with functioning A/C
Processing:

- Source: NYC Public Schools
- Most Recent Data Update: 2025
- Assumptions: This only includes information from schools surveyed (89 percent of buildings)—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms are surveyed. These "traditional classrooms" are considered rooms labeled as Regular Classrooms functioning for Instructional Space or Under Construction, or Other room spaces with area greater than 500 square feet functioning as Instructional Space or Under Construction. Some rooms are listed as having received a quote for the work of fixing or adding electrical needed for functional A/C. We have not included these in the "no electric" manual indexing process because they may be in the process of getting fixed.
- Notes: Note that not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses

are not available relied on QGIS NYS based geocoding software and manual searches, which could include georeferencing errors.

Indicator 2 (Final Indicator) – Central A/C – school classrooms

Description: Proportion of school instructional, traditional rooms that have central A/C
Processing:

- Source: NYC Public Schools
- Most Recent Data Update: 2025
- Assumptions: Only includes information from schools surveyed—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms were surveyed. These "traditional classrooms" were considered rooms labeled as Regular Classrooms functioning for Instructional Space or Under Construction, or Other room spaces with area greater than 500 square feet functioning as Instructional Space or Under Construction.
- Notes: Note that not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that there is some overlap with the A/C prevalence—schools Indicator, as rooms with central A/C are considered alongside removal A/C units. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses are not available relied on QGIS NYS based geocoding software and manual searches, which could include georeferencing errors.

Indicator 3 (Final Indicator) – A/C capacity – school classrooms

Description: Proportion of school instructional, traditional rooms that have electrical capacity for A/C
Processing:

- Source: NYC Public Schools
- Most Recent Data Update: 2025
- Assumptions: Only includes information from schools surveyed—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms are surveyed. These "traditional classrooms" are considered rooms labeled as Regular Classrooms functioning for Instructional Space or Under Construction, or Other room spaces with area greater than 500 square feet functioning as Instructional Space or Under Construction. This Indicator measures the capacity of traditional classrooms to receive A/C without system intervention. Rooms are considered to not have

capacity if in the survey they are identified as having no dedicated outlet, no ritter kit, no electric, or a combination of these conditions.

- Notes: Note that not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses are not available relied on QGIS NYS based geocoding software and manual searches, which could include georeferencing errors.

Indicator 4 (Primary Indicator) – A/C prevalence – school assembly

Description: Proportion of school assembly spaces with functioning A/C
Processing:

- Source: NYC Public Schools
- Most Recent Data Update: 2025
- Assumptions: This only includes information from schools surveyed (89 percent of buildings)—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms are surveyed. Assembly spaces are considered as Auditorium, Cafeteria, Library, Multipurpose, or Gym spaces.
- Notes: Not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses are not available relied on QGIS NYS based geocoding software and manual searches, which could include georeferencing errors.
- Final Indicator: *A/C prevalence – school assembly* is combined with two other Indicators—*central A/C – school assembly* and *A/C capacity – school assembly*—to comprise the *A/C – school assembly* Final Indicator.

Indicator 5 (Modifier) – Central A/C – school assembly

Description: Proportion of school assembly spaces that have central A/C
Processing:

- Source: NYC Public Schools

- Most Recent Data Update: 2025
- Assumptions: Only includes information from schools surveyed—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms are surveyed. Assembly spaces are considered as Auditorium, Cafeteria, Library, Multipurpose, or Gym spaces.
- Notes: Not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that there is some overlap with the A/C prevalence—schools Indicator, as rooms with central A/C are considered alongside removal A/C units. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses are not available relied on QGIS NYS based geocoding software and manual searches, which could include georeferencing errors.
- Final Indicator: *Central A/C – school assembly* is combined with two other Indicators—*A/C prevalence – school assembly* and *A/C capacity – school assembly*—to comprise the *A/C – school assembly* Final Indicator.

Indicator 6 (Modifier) – A/C capacity – school assembly

Description: Proportion of school assembly spaces that have electrical capacity for A/C
Processing:

- Source: NYC Public Schools
- Most Recent Data Update: 2025
- Assumptions: Only includes information from schools surveyed—these schools are public schools that manage their own school facilities with a custodial engineer. Private schools are not captured. Not all schools or rooms are surveyed. Assembly spaces are considered as Auditorium, Cafeteria, Library, Multipurpose, or Gym spaces. This indicator measures the capacity of traditional classrooms to receive A/C without system intervention. Rooms are considered to not have capacity if in the survey they are identified as having no dedicated outlet, no ritter kit, no electric, or a combination of these conditions.
- Notes: Note that not every NTA has an evaluation for this KPI—a few NTAs don't have schools that are inventoried for the A/C survey. NTAs without data for this KPI are not discounted in their scores—category scores for those NTAs are calculated without this KPI. Note that a few instances of double counting of classrooms are removed, as well as few instances where central A/C appeared to have been installed in only a single room in the building with no further details. The A/C survey is a snapshot in time and A/C prevalence may change. Some schools may change locations or layouts and school lists and locations are identified based on 2019-2020 school location data and 2021 school-room comparisons. Some data where addresses

are not available relied on QGIS geocoding and manual searches, which could include georeferencing error.

- Final Indicator: *A/C capacity – school assembly* is combined with two other Indicators—*A/C prevalence – school assembly* and *Central A/C – school assembly*—to comprise the *A/C – school assembly* Final Indicator.

COASTAL FLOOD EXPOSURE KPIS

Note that at this time, coastal flood KPIs include only individual building- or unit-level protections through Appendix G of the NYC Building Code (see more details in the following subsections). In the future, OMB aims to include protections from other standards, particularly large coastal flood protection barriers, such as the NYC East Side Coastal Resiliency Project, and design guidelines. Many large-scale coastal flood barriers and similar plans, which would provide swaths of protection, will be completed in coming years, so they are not included as KPIs at this time. Furthermore, other measures could include places that are able and designed to flood to reduce unwanted flooding elsewhere, whereas the measures included at this time focus on the ability to resist water intrusion (outside of floodproofing certificates through the Department of Buildings, DOB). Lastly, building protections here include those largely for a full building; other protections, including elevated equipment or mechanicals, emergency backup power, or other partial protections could be considered in the future.

Note that building criticality is not a standardized definition. Criteria are considered by examining Appendix G, the NYCEM Hazard Mitigation Plan and the CRDG. However, the categories do not perfectly overlap, and criteria are tailored to this analysis—in the future, further alignment between definitions of "critical" buildings will be considered, including for infrastructure, which is currently not included here.

Category 7 – Area Physically Protected – Non-Critical Buildings

Indicator 1 and 2 (Final Indicator) – Buildings at risk protected by building code requirements (1. previous; 2. contemporary)

Description: Proportion of buildings within FEMA 2007 FIRM or 2015 PFIRM with building-level flood protections as expected by implementation of the NYC Building Code (non-critical buildings, and not solely residential buildings)

Processing:

- Source: DOBNOW, DOB Building Information Search; NYC DCP Primary Land Use Tax Lot Output[74]
- Most Recent Data Update: 2025
- Assumptions: Only includes properties where use type is not solely residential—mixed use properties are included. At this time, all properties with likely protections are included in the data set, though some properties have protections built to contemporary standards and

others used now-outdated standards at the time of construction. Not all buildings that would likely have been subject to Appendix G flood-resistant standards may in actuality be built to those standards, which could result in overestimating the proportion of buildings in the floodplain that have protections. Also note that some buildings may elect to have protections without it being required, having fallen into our search criteria or being disclosed to the DOB, which could lead to underestimating the number of buildings with protections in the floodplain. Only the proportion of buildings with likely protections in the floodplain out of all buildings in the floodplain are calculated (buildings not in the FEMA Special Flood Hazard Area (SFHA) are excluded, here both the FIRM and PFIRM areas). Analyzed data does not fully extend as far back as 1983, due to limitations on historical data availability. Flood maps incur some periodic revisions for minor areas—only the 2015 FEMA PFIRM and 2007 FIRM are used in these analyses, though there have been updates throughout to various areas.

- Notes: Building permit requirements for flood-resistant construction have changed over time, including shifting from using the "base flood elevation" to a generally more protective (higher elevation) "design flood elevation." Levels of protection are considered based on date of permitting and associated requirements. Information on building protections has not been validated on the ground for the purposes of these analyses and they represent desktop exercises on the basis of legal building requirements.

Indicator 3 (Final Indicator) – Buildings at risk protected by coastal measures

Description: Proportion of buildings within FEMA 2007 FIRM or 2015 PFIRM that are protected because they exist behind a flood barrier or other coastal adaptation strategy (non-critical buildings, and not solely residential buildings)

Processing:

- Not included yet at this time because most flood barrier projects are still being designed and constructed, but included in the future projections (see later sections) in the future as more coastal assets such as flood walls come online.

Category 8 – Area Physically Protected – Residential Units

Indicator 1 and 2 (Final Indicator) – Residential units at risk protected by building code requirements (1. previous; 2. contemporary)

Description: Proportion of residential building units within FEMA 2007 FIRM or 2015 PFIRM with building-level flood protections as expected by implementation of the NYC Building Code

Processing:

- Source: DOBNOW, DOB Building Information Search; NYC DCP Primary Land Use Tax Lot Output[75]
- Most Recent Data Update: 2025
- Assumptions: Only residential properties—mixed use properties are included. At this time, all properties with likely protections are included in the data set, though some properties have

protections built to contemporary standards and others used now-outdated standards at the time of construction. Not all buildings that would likely have been subject to Appendix G flood-resistant standards may in actuality be built to those standards, which could result in overestimating the proportion of buildings in the floodplain that have protections. Also note that some buildings may elect to have protections without it being required, having fallen into our search criteria or being disclosed to the DOB, which could lead to underestimating the number of buildings with protections in the floodplain. Only the proportion of buildings with likely protections in the floodplain out of all buildings in the floodplain are calculated (buildings not in the FEMA Special Flood Hazard Area (SFHA) are excluded, here both the FIRM and PFIRM areas). Residential units are aggregated if a Building Identification Number (BIN) or Borough Block Lot (BBL) had records of a floodproofing measures implemented.

- For BBLs with multiple buildings (e.g., co-ops, campuses), the following assumptions are made:
    - If the number of building records matched the number of buildings within the BBL, the entire campus was considered protected, including all units
    - If the number of building records is less than the number of buildings within the BBL, the percentage of records compared to total buildings is calculated, and the resulting ratio is applied to the total number of units.
    - If the number of building records is less than the number of buildings within the BBL *and* the additional building is determined to be an accessory building (e.g., garage, shed), the residential unit was determined to be fully covered (count of properties with accessory buildings that could not be matched directly to BINs: 311 BBLs)

Analyzed data does not fully extend as far back as 1983, due to limitations on historical data availability. Flood maps incur some periodic revisions for minor areas—only the 2015 FEMA PFIRM and 2007 FIRM are used in these analyses, though there have been updates throughout to various areas.

- Notes: Building permit requirements for flood-resistant construction have changed over time, including shifting from using the "base flood elevation" to a generally more protective (higher elevation) "design flood elevation." Levels of protection are considered based on date of permitting and associated requirements. Note that no information on building protections has been validated on the ground for the purposes of these analyses and they represent desktop exercises based on legal building requirements.

Indicator 3 (Final Indicator) – Residential units at risk protected by coastal measures

Description: Proportion of residential building units within FEMA 2007 FIRM or 2015 PFIRM that are protected because they exist behind a flood barrier or other coastal adaptation strategy
Processing:

- Not included yet at this time because most flood barrier projects are still being designed and constructed, but included in the future projections (see later sections) as more coastal assets such as flood walls come online.

Category 9 – Area Physically Protected – Critical Buildings

Indicator 1 (Final Indicator) – Critical buildings at risk protected by building code requirements

Description: Proportion of critical buildings within FEMA 2007 FIRM or 2015 PFIRM with flood protections as expected by implementation of the NYC Building Code
Processing:

- Source: DOBNOW, DOB Building Information Search; NYC DCP Primary Land Use Tax Lot Output[76]
- Most Recent Data Update: 2025
- Assumptions: Only critical facilities as defined above included—other critical facilities may exist and for the purposes of future exercises, infrastructure will likely be included as separate, though this is not included in any of the categories here at this time and may arguably be critical (e.g., wastewater treatment, public transit). At this time, all properties with likely protections are included in the data set, though some properties have protections built to contemporary standards and others used now-outdated standards at the time of construction. Not all buildings that would likely have been subject to Appendix G flood-resistant standards may in actuality be built to those standards, which could result in overestimating the proportion of buildings in the floodplain that have protections. Also note that some buildings may elect to have protections without it being required, having fallen into our search criteria or being disclosed to the DOB, which could lead to underestimating the number of buildings with protections in the floodplain. Only the proportion of buildings with likely protections in the floodplain out of all buildings in the floodplain are calculated (buildings not in the FEMA Special Flood Hazard Area (SFHA) are excluded, here both the FIRM and PFIRM areas). Analyzed data does not fully extend as far back as 1983, due to limitations on historical data availability. Flood maps incur some periodic revisions for minor areas—only the 2015 FEMA PFIRM and 2007 FIRM are used in these analyses, though there have been updates throughout to various areas.
- Notes: In future iterations of this work, partly and fully protected may be separated out. Building permit requirements for flood-resistant construction have changed over time, including shifting from using the "base flood elevation" to a generally more protective (higher elevation) "design flood elevation." At this time buildings are grouped together for having any protections. Information on building protections has not been validated on the ground for the purposes of these analyses and they represent desktop exercises on the basis of legal building requirements. The definition of "critical" buildings is tailored at this time for this analysis and may be reconsidered in the future to be more or less inclusive. Hospitals are required to have protections to the 500-year storm, but this is not accounted for at this time outside of the

100-year floodplain—this will be considered in future in a separate category related to large asset protections that are neither standard building code requirements for new builds or renovations or neighborhood-level coastal barriers.

Indicator 2 (Final Indicator) – Critical buildings at risk protected by coastal measures

Description: Proportion of critical buildings within FEMA 2007 FIRM or 2015 PFIRM that are protected because they exist behind a flood barrier or other coastal adaptation strategy
Processing:

- Not included yet at this time because most flood barrier projects are still being designed and constructed, but included in the future projections (see later sections) as more coastal assets such as flood walls come online.

Category 10 – Area Financially Protected

Indicator 1 (Final Indicator) – Insured non-critical buildings

Description: Proportion of non-critical properties within FEMA 2007 FIRM or 2015 PFIRM with flood insurance (non-residential uses, though mixed use included)
Processing:

- Source: U.S. Federal Emergency Management Agency
- Most Recent Data Update: 2025
- Assumptions: This only includes data through the FEMA National Flood Insurance Program (NFIP), though buildings may carry flood insurance through other private carriers. Additionally, this only includes a calculation of properties in the FIRM and PFIRM that carry NFIP flood insurance, though other properties may carry insurance and only properties in the FIRM with federally backed mortgages are required at this time to carry flood insurance through the program. FEMA states that as of 2024, 40 percent of flood insurance claims occur outside of high flood-hazard areas and that federally 82 percent of properties in the Special Flood Hazard Area do not have NFIP coverage.[77] This KPI does not account for the level of insurance protection or repetitive claims/losses, just the presence of insurance. Mixed use properties included.
- Notes: The methodology changed from the previous year to newly include policy-level data instead of contract-level data. This is most relevant for residential building spaces.

Indicator 2 (Final Indicator) – Insured residential buildings

Description: Proportion of residential properties within FEMA 2007 FIRM or 2015 PFIRM with flood insurance
Processing:

- Source: U.S. Federal Emergency Management Agency

- Most Recent Data Update: 2025
- Assumptions: This only includes data through the FEMA National Flood Insurance Program (NFIP), though buildings may carry flood insurance through other private carriers. Additionally, this only includes a calculation of properties in the FIRM and PFIRM that carry NFIP flood insurance, though other properties may carry insurance and only properties in the FIRM with federally backed mortgages are required at this time to carry flood insurance through the program. FEMA states that as of 2024, 40 percent of flood insurance claims occur outside of high flood-hazard areas and that federally 82 percent of properties in the Special Flood Hazard Area do not have NFIP coverage.[78] This KPI does not account for the level of insurance protection or repetitive claims/losses, just the presence of insurance. Mixed use properties included.
- Notes: The methodology changed from the previous year to newly include policy-level data instead of contract-level data. This is most relevant for residential building spaces.

Indicator 4 (Final Indicator) – Insured critical buildings

Description: Proportion of critical properties within FEMA 2007 FIRM or 2015 PFIRM with flood insurance

Processing:

- Source: U.S. Federal Emergency Management Agency
- Most Recent Data Update: 2025
- Assumptions: At this time, data are calculated for policy contracts at the building level, though there may be individual policies within. This only includes data through the FEMA National Flood Insurance Program (NFIP), though buildings may carry flood insurance through other private carriers. Additionally, this only includes a calculation of properties in the FIRM and PFIRM that carry NFIP flood insurance, though other properties may carry insurance and only properties in the FIRM with federally backed mortgages are required at this time to carry flood insurance through the program. FEMA states that as of 2024, 40 percent of flood insurance claims occur outside of high-hazard flood areas and that federally 82 percent of properties in the Special Flood Hazard Area do not have NFIP coverage.[79] This KPI does not account for the level of insurance protection or repetitive claims/losses, just the presence of insurance.
- Notes: The methodology changed from the previous year to newly include policy-level data instead of contract-level data. This is most relevant for residential building spaces.

STORMWATER FLOOD EXPOSURE KPIS

OMB developed inventory analysis for stormwater, but this is considered preliminary at this point, because it does not yet include information on sewer capacity, which is an important indicator of stormwater adaptation. OMB will update this in the future according to DEP's ongoing stormwater analysis.[80]

Category 11 – Water Managed by Trees

Indicator 1 (Primary Indicator) – Tree canopy cover

Description: Proportion of land surface (aerial) overlapped by tree crowns
Processing:

- Source: NYC Open Data Land Cover Raster Data—6in Resolution[81]
- Most Recent Data Update: 2022
- Assumptions: Source data assumes vegetation greater than 8 feet is tree canopy and less than 8 feet is grass/shrub; Data determined using aerial imagery, not on-the-ground surveys.
- Notes: Future data updates will be conducted every five years as per LL148 of 2023. Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Tree canopy cover* is combined with two other KPIs—*contiguous canopy* and *tree canopy over greenspace*—to comprise the *tree canopy* Final Indicator.

Indicator 2 (Modifier) – Tree canopy over greenspace

Description: Proportion of tree canopy that overlaps with vegetated area
Processing:

- Source: NYC Open Data Land Cover Raster Data—6inch Resolution;[82] NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[83]
- Most Recent Data Update: 2022
- Assumptions: Source data assumes vegetation greater than 8 feet is tree canopy and less than 8 feet is grass/shrub; Data determined using aerial imagery, not on-the-ground surveys.
- Classification of green spaces are "grass/bush", per DEP.
- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here. Both features are complimentary in the same dataset; to identify intersecting polygons, the "Select by Location" tool is used to pull the area of overlap.
- Final Indicator: *Tree canopy over greenspace* is combined with two other KPIs—*tree canopy cover* and *contiguous canopy*—to comprise the *tree canopy* Final Indicator.

Indicator 3 (Final Indicator) – Fulfilled tree potential

Description: Proportion of potential tree canopy growth area that has existing canopy
Processing:

- Source: Practical Canopy for New York City;[84] Understanding Opportunities for Urban Forest Expansion to Inform Goals: Working Toward a Virtuous Cycle in New York City;[85] NYC Open

Data Parks and Recreation Forestry Tree Points;[86] NYC Open Data Building Footprints;[87] NYC Open Data Land Cover Raster Data—6in Resolution[88]

- Most Recent Data Update: 2022
- Assumptions: A buffer around each Forestry Tree Point is selected as 4.11 meters in radius (8.22 diameter of canopy per tree), which is calculated by Treglia et al. (2022) using the average diameter of trees owned by the NYC Parks Department for the most common ten species.[89] This included tree planting spaces in the right-of-way that do not have live trees in them (such as stumps or dead trees, or empty tree beds). Hypothetical canopy extents are then clipped by building areas according to the city's Building Footprints dataset provided by the NYC Department of Technology and Innovation. This is used to achieve a "potential" canopy value for street trees. Some street trees' aerial canopy cover extents already cover some or all of the potential area, which would be classified as the fulfilled area. Existing trees may go beyond the hypothetical extents in real cases, such as for mature trees, and these overhangs is not considered in the ratio—these are additional canopy areas beyond the "potential" extents.
- Notes: Some data, such as tree planting spots are updated frequently, but the update date of this overall KPI is considered to be 2017 due to that being the most recent update of the LiDAR Raster survey.

Indicator 4 (Final Indicator) – Tree health

Description: Street trees' conditions as assessed by the New York City Parks Department (proportion of street trees with Fair, Good, or Excellent health)

Processing:

- Source: NYC Open Data Parks and Recreation Forestry Tree Points[90]
- Most recent update: 2022
- Assumptions: Trees are considered "healthy" if they are rated by the NYC Parks Department as Fair, Good, or Excellent. The proportion of street trees included all categories of tree condition (Excellent, Good, Fair, Poor, Critical, Dead, Unknown). The canopy area of trees that met the criteria listed above are extracted from the possible tree point classifications and the resulting "healthy canopy area" of the resulting points are translated per neighborhood.
- Notes: None

Indicator 5 (Final Indicator) – Tree guards

Description: Proportion of street trees with guards around their tree pits

Processing:

- Source: The NYC Parks Department Neighborhood Tree Planting Program; 2015 Street Tree Census – Tree Data;[91] NYC Open Data Parks and Recreation Forestry Tree Points[92]
- Assumptions: All tree guards from the Neighborhood Tree Planting Plan are considered, and only those tree guards in the 2015 Street Tree Census deemed Helpful (not Harmful or Unsure).[93]
- Notes: None

Category 12 – Water Managed by Permeable Surfaces

Indicator 1 (Primary Indicator) – Permeable surface cover

Description: Proportion of surfaces that allow for water infiltration
Processing:

- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[94]
- Most Recent Data Update: 2020
- Assumptions: This includes what DEP considers in analysis to be both "semi-pervious" and "pervious," which includes the land cover classes: gravel, synthetic turf, bare soil, sand, grass, bush, and tree.[95] Permeable surfaces do not likely include engineered porous pavements, as these would likely present in a LiDAR analysis as asphalt or concrete. Trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features as in the *Stormwater Flooding Managed by Trees* Indicator Category described above.
- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Permeable surface cover* is combined with two other KPIs—*greenspace cover* and *permeability coefficient*—to comprise the *permeable surfaces* Final Indicator.

Indicator 2 (Modifier) – Greenspace cover

Description: Proportion of surface area covered by vegetation
Processing:

- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[96]
- Most Recent Data Update: 2020
- Assumptions: This includes what DEP considers in analysis to be grass, bush, and tree.[97] It is important to note that trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features as in the *Stormwater Flooding Managed by Trees* Indicator Category described above.
- Notes: Tree canopy details the overhang of tree leaves, whereas the permeable surfaces describe the surfaces, which include tree planted areas and vegetative cover. Different mechanisms of cooling and measurement are included here.
- Final Indicator: *Greenspace cover* is combined with two other KPIs—*permeable surface cover* and *permeability coefficient*—to comprise the *permeable surfaces* Final Indicator.

Indicator 3 (Modifier) – Permeability coefficient

Description: Weighted average of permeabilities associated with substrate type
Processing:

- Source: NYC Open Data DEP Citywide Parcel-Based Impervious Area GIS Study[98]
- Most Recent Data Update: 2020

- Assumptions: Permeability coefficients are averages and are typically assigned ranges for different substrate types. The average may or may not accurately reflect the permeability in practice, including if it is clogged or compacted. Weighted averages of permeability for each substrate type are taken by area, for each NTA. This includes what DEP considers in analysis to be both "semi-pervious" and "pervious," which includes the land cover classes: gravel, synthetic turf, bare soil, sand, grass, bush, and tree.[99] Trees are considered permeable surfaces in the DEP land classification, but this is not measuring the same features as in the *Stormwater Flooding Managed by Trees* Indicator Category described above.
- Notes: Permeable surfaces do not likely include engineered porous pavements, as these would likely present in a LiDAR analysis as asphalt or concrete. These specialty pavements (a type of green-grey infrastructure), though porous, are not added into this KPI as they are included in Green Infrastructure below.
- Final Indicator: *Permeability coefficient* is combined with two other KPIs—*permeable surface cover* and *greenspace cover*—to comprise the *permeable surfaces* Final Indicator.

Category 13 – Water Managed by Green Infrastructure

Indicator 1 (Final Indicator) – Green infrastructure installations

Description: Area of green infrastructure that helps to collect stormwater
Processing:

- Source: Open Data Department of Environmental Protection Green Infrastructure[100]
- Most Recent Data Update: 2025
- Assumptions: Green infrastructure is included if it is tracked by the Department of Environmental Protection. However, other green infrastructure assets may exist, such as those on private property that are self-funded. Some private installments are included in this dataset if they are incentivized by the government, such as through the Green Infrastructure Grant Program.[101] However, most are publicly owned. This represents an underestimation of green infrastructure. Values are aggregated by NTA by the summed area of all green infrastructure installations of different types in the NTA as this is the level of data available. Note that this may not represent an ideal relationship to the water managed, as depths and design of green infrastructure, in addition to the area, implicate water volume capacity.
- Notes: Green infrastructure refers to the systems put in place to collect stormwater from hard surfaces before they can enter the sewer system or cause local flooding.[102] These can refer to measures in the right of way, such as raingardens on sidewalks, those on sites such as parks, porous pavements, green roofs, and others. Note that at this time Bluebelts are not included and cloudburst hubs are not counted separately or additionally from their constituent installments, though both of these types of green infrastructure act as large systems. These will likely be included in this tool in some way, such as through a separate metric of "system-wide" coverage, though this is still to be determined. Asset Types selected for this Indicator are listed below.

FIGURE | GREEN INFRASTRUCTURE ASSET TYPES

Blue Roofs	"Multiple GI Components"	ROW Permeable Pavement
Cisterns	Permeable Pavers	ROW Porous Asphalt
Combined Blue/Green Roof	Porous Asphalt	ROW Porous Concrete
Constructed Wetlands	Porous Concrete	ROWB
Detention System	Rain Garden	ROWEB
Detention System (connected to sewer)	Rainwater Harvesting	ROWGS
Drywell	Rooftop Farm	ROWRG
Engineered Soil Tree Pit	ROW Infiltration Basin with Combination of Concrete and Grass Top	ROWSGS
Green Roof	ROW Infiltration Basin with Concrete Top	Subsurface Detention System
Impervious Area Reduction	ROW Infiltration Basin with Grass Top	Subsurface Storage
Media Filter	ROW Median	Synthetic Turf Field Storage Layer

Figure Source: OMB

Category 14 – Water Managed by Wetlands

Indicator 1 (Final Indicator) – Wetland area

Description: Proportion of land cover that is natural wetland area
Processing:

- Source: NYC Open Data Wetlands Map;[103] U.S. Geological Survey Wetlands Mapper[104]
- Most Recent Data Update: 2026
- Assumptions: This does not necessarily include engineered spaces such as green infrastructure Bluebelts,[105] but may incorporate these features where they are built into existing wetland areas. Double counting may occur between canopy cover and forested wetland area for forested wetlands, though wetlands take unforested forms and may provide benefits separate from the canopy benefits alone. Furthermore, double counting may occur between this Indicator and permeable surfaces/greenspace, but wetlands provide more substantial benefits compared to other vegetated spaces. This dataset removes Estuarine-Water and related polygons, such as riverine features from the area calculation, due to area calculation inaccuracies observed.
- Notes: Wetlands are included if they are included in the NYC Parks Department's wetland inventory, as well as the NY State and U.S. Federal wetlands delineations. The NYC Parks Department's wetlands are mapped using remote sensing analysis in conjunction with the University of Vermont. The NYC Parks Department has verified and updated this through an assessment with the Natural Areas Conservancy on the ground.

Indicator 2 (Final Indicator) – Wetland health

Description: Percent of wetland area that is classified as Healthy, Threatened, or In Transition
Processing:

- Source: NYC Nature Map;[106] Natural Areas Conservancy; U.S. Geological Survey Wetlands Mapper[107]
- Most Recent Data Update: 2014
- Assumptions: Only city-owned wetland property is assessed, though much wetland space may be privately owned. Only "degraded" as a classification is not included in the determination of wetlands as having high health, as this represents wetlands where substantial restoration is needed. The health assessment is conducted by the NYC Parks Department and Natural Areas Conservancy according to rubrics for salt marshes, freshwater wetlands, and streams outlined in the 2021 Wetlands Management Framework and for forested wetlands outlined in the 2018 Forest Management Framework.[108]

Category 15 – Water Managed by Sewer Coverage

Indicator 1 (Final Indicator) – Area served by sewers

Description: The proportion of city area that receives sewer service by either combined or separate sewer pipes.
Processing:

- Source: NYC DEP Sewershed Map[109]
- Most Recent Data Update: 2020
- Assumptions: Understanding the areas serviced by different types of sewers may be a first step, but is not sufficient for capturing the amount of water conveyed. Until conveyance information can be incorporated, this is a partial proxy.
- Notes: Most of the city area is covered by sewers/direct outlet drainage.

Indicator 2 (Final Indicator) – Separate sewer coverage

Description: The proportion of city area that receives separate (MS4) sewer service.
Processing:

- Source: NYC Open Data Municipal Separate Storm Sewer System (MS4) Data[110]
- Most Recent Data Update: 2020
- Assumptions: This assumes that separate sewers will benefit stormwater management compared to combined sewers, though this may be dependent on other conditions, such as the size and location of pipes. Until more precise conveyance information can be incorporated, this is a partial proxy.

LIMITATIONS

Measuring KPIs as proportions allows for inter-neighborhood comparisons, but also has downsides compared to evaluating overall levels of protection across locations. For example, a neighborhood with five out of 10 protected buildings from coastal flooding would show as being 50 percent protected, whereas a neighborhood with 200 of 1,000 buildings protected would show up as 20 percent. More buildings are protected in the latter example and the average protective level across neighborhoods is not 35 percent (the average), but rather 20.3 percent.

Scores are impacted by the KPIs chosen–including a different set of KPIs would change the results. Scores may also be skewed by data availability. While KPIs are chosen for their applicability across geographies, data gaps may exist.

Weightings are inherently subjective and may not accurately represent the directionality or level of relative importance of KPIs. Furthermore, some KPIs may be more important for some locations over others, though at this time KPI weightings are applied uniformly to all NTAs. In the future, weightings could be applied to each NTA depending on their individual vulnerability, hazard, or level of attainment, need, or potential for each KPI, if enough data are available.

At this time, infrastructure and out-of-city networks are largely excluded from analysis. For example, coastal protective measures for city streets and transit networks are important for considering impacts to residents, visitors, and public infrastructure. Similarly, telecommunications, power, and other utilities that are not solely within the city purview are pertinent for measuring resiliency. These types of metrics are not included in this iteration due to complexity of analysis. This will be a focus of future inquiry.

At this time, KPIs for stormwater flooding are limited. The NYC DEP is undergoing an in-depth stormwater analysis and this will be a point of collaboration to investigate expanding this area of Climate Budgeting work in tandem in future years.[111]

Scoring here only conveys effects of adaptive measures additively–all KPIs are treated as complementary in the indexing, augmented only by their weighting. In actuality, some KPIs may interact with others in ways that are more than the sum of their parts (e.g., tradeoffs, multiplicative effects, etc.). For example, in some but not all cases redundant protections are important for resiliency, as they reduce the risk when one intervention fails (e.g., the break or overtopping of a flood barrier), so they cannot be considered interchangeable.

RESILIENCY EXPOSURE FORECAST

This analysis evaluate the scope of planned adaptation initiatives and their potential to reduce exposure to escalating climate risks. While it is not feasible to mitigate all risks across every type and magnitude of climate event, it is essential to assess which risks are likely to be addressed through planned adaptation efforts and how these measures affect future risk. At this stage, three hazards were treated with various forecasting exercises to compare what the future could be like with and without targeted adaptation efforts.

OVERVIEW

The document walks through the steps OMB undertakes to forecast resiliency *exposure*. Refer to previous sections for more information on exposure versus hazards and vulnerability. For more information about prior year's methodology, including the Outdoor Heat Air Temperature Forecast, please refer to the FY26 Climate Budget Publication's Technical Appendices.

FORECAST PLANNING

To forecast the effects of targeted actions on hazard exposure–referred to as Planned Actions–OMB uses projections of climate conditions developed by the NPCC for decadal periods out to 2050. For each hazard, described individually in the following sections, neighborhood-level (NTA) data are used to project the impact of those adaptation measures, and the residual risk that remains.

For each hazard's forecast, a Control Scenario is developed for each decade serving as an example of the future under business-as-usual conditions, followed by one or more Planned Action Scenarios of potential action. The Control Scenario reflects changes determined solely by NPCC climate projections, without incorporating any other changes in city conditions or the broader contextual environment. The Planned Action Scenarios are based off the Control and add in Planned Actions that represent potential changes to the city in preparation for and response to worsening risks. These are likely to alleviate some of the future risk compared to the Control Scenario by providing adaptation solutions at scale.

Planned Actions forecasted for this iteration are:

- Increased canopy due to growth and planting: Canopy growth refers to the natural expansion of trees from growing year-on-year. Planting is a manual intervention conducted by the city. Canopy size implicates widescale outdoor heat as trees exchange water in the air. Trees are just one strategy to reduce outdoor heat.

- Neighborhood-scale coastal flood barriers in the face of high-tide and storm-surge flooding: These reflect large physical protective measures located on the coasts and around water bodies in the city. This is just one type of measure, as individual buildings can also protect themselves and neighborhoods can build other forms of resiliency, such as emergency preparedness and natural measures.

FIGURE | FORECASTED PLANNED ACTIONS

Outdoor Heat	**Coastal Flooding (Two Parts)**
Increasing canopy cover due to: 1. Tree growth 2. Street tree planting	Construction of neighborhood-scale coastal flood barriers for: 1. High-tide flooding 2. Storm-surge flooding (with sea-level rise) Presence of federal projects, such as the NY & NJ Harbor and Tributaries Feasibility Study (NYNJHATS)

Limitations

Planned Actions are a partial picture of adaptive measures and do not represent all the work being done that could impact the effects of climate change on communities. In future iterations, more Planned Actions will be considered, along with other ways to show future adaptation scenarios. Planned Actions may be changed at any point and inclusion here does not mean these efforts cannot be altered, cancelled, or augmented. Analysis will be updated in future to account for changes to the science, project design, program parameters, and other considerations.

At this time, Planned Actions and Control scenarios are developed using single NPCC projections (see below sections for details for each hazard). In the future, projections could be conducted using several NPCC scenarios to show a range of forecasted impacts based on climate conditions.

While the outdoor heat and coastal flooding forecast is conducted at the NTA level, any spatial scale will come with caveats. NTAs are still too large to account for changes in felt impacts at a fine scale (e.g., the felt heat under a tree or the impact of flooding from one block to the next) and are also too small to account for connected, system-wide impacts (e.g., transit networks that route through impacted neighborhoods). This will be investigated more in the future.

OUTDOOR HEAT FORECAST

How does the forecast approach local outdoor heat?

The inventory identifies baseline levels of adaptation measures in areas that face present levels of exposure to increasing temperatures. As highlighted in the inventory's results, heat-related risks and adaptation measures are unevenly distributed across neighborhoods. This necessitates spatially sensitive modeling approaches. The NYC Health Department has identified neighborhood environmental and social factors associated with increased risk to create the HVI, which has historically been used by the city to prioritize neighborhoods when implementing solutions to mitigate heat risk. This includes the NYC Parks Department's decisions on where street trees may be planted to maximize return on investment and reduce inequities.

Increasing Canopy Cover

- The tree canopy cover Planned Actions aligns with the city's commitment to achieve 30 percent canopy coverage outlined in *PlaNYC and the city's Urban Forest Plan*.

  This work toward achieving 30 percent canopy cover is being realized through the recent Urban Forest Plan, as required by Local Law 148 of 2023.[112]

- Reaching a 30 percent canopy goal from the city's current level of coverage requires an additional 15,388 acres of canopy across public and private property that can be achieved in two primary ways:[113]

  1. Preserve, steward, and protect existing trees to reasonably maximize canopy growth
  2. Planting new trees

For information on how these methods relate to changes in air temperature, please see the Technical Appendices for the FY26 Climate Budget Publication.

Determining Decadal Canopy

Canopy growth and planting are considered part of the Planned Actions scenario. However, planting and growth are part of the NYC Parks Department's longstanding work and tree stewardship may happen regardless of the specific Neighborhood Tree Planting Program plans. However, these are concerted efforts and are deemed to be appropriate as Planned Actions.

According to the two most recent LiDAR surveys for which data are available at the time of analysis, between 2017 and 2021, the city's urban canopy—its total tree cover—grew. This finding includes both gains in canopy cover and the loss of canopy from tree mortality, tree removal for development, and other effects. OMB refers to the net growth rate as the “growth rate” throughout and this accounts for loss and gain.

To accurately project future changes, it is necessary to understand how much the canopy has expanded relative to is previous size, not just a citywide average. This provides a growth rate over time. This is calculated by the following formula:

((Canopy Gained - Canopy Lost) / Previous Canopy Area (i.e., for year 2017)) x 100

The Urban Forest Plan highlights how the city’s canopy has changed by property typology. Typologies are informed by the Department of City Planning’s PLUTO dataset and refined by the Nature Conservancy to provide additional context for the city’s rights-of-way, among others. The relative change in canopy by property type is placed below:

Annualized Relative Canopy Change, by property type: 2017-2021.

Land Use Description	Relative Canopy Change (%)
Public:	
City: NYC Parks	2.346270927
City: Other	1.312104879
City: Rights of Way	2.114905997
Federal	3.696681963
Private	0.239438385
State	1.280531119
Private Property:	
Cemeteries	1.037915319
Nonresidential Developed	0.599675241
Parks and Rec	1.072832622
Public Facilities and Institutions	1.047080731
Residential 1 and 2 Family	-0.249622201
Residential 3+ Family and Mixed-Use Commercial	0.429696183
Vacant Land	1.144296375

To estimate canopy growth for existing canopy to the appropriate decadal interval, growth is estimated using the Variable Percentage Buffer tool in QGIS. Once the buffers are induced, the percent area coverage is calculated per NTA using the Overlap Analysis tool, one for each time interval:

- 2021 (benchmark)
- 2030
- 2040
- 2050
- 2055

In addition to natural growth of existing canopy, canopy change is also driven by the strategic planting of street trees. To forecast tree planting, OMB followed these steps:

- **Data Source**: Analysis is based on information on planned implementation of the Neighborhood Tree Planting Program by the NYC Parks Department. The NYC Parks Department Department's Neighborhood Tree Planting program aims to plant the entire city on a 9-year cycle—prioritizing the most heat-vulnerable neighborhoods first. Growth Rates were provided by The Nature Conservancy, WXY, through a collaboration with MOCEJ
- **Planting Zone Categorization**: Neighborhoods are divided into planting zones based on the NYC Parks Department's plans. Each zone is assigned 1) a "planting potential" total count (number of potential planting spots); and 2) a year for expected planting, scheduled between 2024 and 2035.
- **Tree Placement and Forecasting Approach**: Random points are assigned within each planting zone, with the number of points per zone (N) corresponding to the total potential planting spots identified by the NYC Parks Department. Tree planting potential is assessed by the NYC Parks Department through a combination of desktop and field analysis. OMB's forecasting relies on these assessments, using distribution within planting zones. Grown tree crowns were clipped if intersected with buildings larger than 30 feet, to account for potentially overestimating growth.
- **Limitations**: While trees may be clustered or planted strategically in reality, the analysis does not determine exact planting locations. Final locations will be decided in future years by Neighborhood Tree Planting Program staff, based on on-site suitability surveys.

To ensure that the randomly assigned street tree canopy would not be duplicative to existing canopy or buffers generated in the prior step (to account for annual existing-canopy growth), the spatial difference of each planting zone is taken of that which overlapped with the 2050 projected canopy coverage before assigning the points to each planting zone polygon.

To determine the size of canopy for newly planted trees, a standard new-tree canopy size is applied across all randomly distributed planting points. This size is determined in consultation with the NYC Parks Department using several resources:

- 2019 Street Tree ID Guide Top 24 List (24 most common street tree species)[114]
- Street Tree Approved Species Planting List (downloaded in February 2025)[115]
- McPherson et al. (2016) allometric equations for urban trees[116]
- NYC Tree Valuation Protocol[117]

The Top 24 list is cross referenced with the Approved Species Planting List to generate 17 species that are common and approved. One of these is removed (*Prunus virginiana)* and 11 added after consultation with the NYC Parks Department. Nine species are not matched for species-specific allometric equations using the sources above and are removed *(Quercus bicolor*, *Styphnolobium japonicum*, *Syringa reticulata*, *Quercus muehlenbergii*, *Quercus imbricaria*, *Quercus lyrata*, *Metasequoia glyptostroboides*, *Acer miyabe*, and *Aesculus glabra*), leaving 17 species in total for consideration (see the table below). Three of these species (*Celtis occidentalis*, *Quercus macrocarpa*, and *Gymnocladus dioicus*) do not have growth coefficients available in the Northeast region, so other regions (such as Midwest U.S.) are used.

All species are calculated for a standard planting size for the NYC Parks Department's street trees of approximately 3-inch caliper (7.62 centimeters). The NYC Parks Department indicates that this would likely result in trunk diameter at breast height for new plantings to be between 1.5 and 2 inches, so 1.5 inches is used as a conservative size. This corresponded to 3.81 centimeter diameter at breast height, which is the input into the species-specific equations, yielding the suggested new-planting canopy diameters for each species.

FIGURE | ESTIMATED CANOPIES BY TREE SPECIES

Tree List	Canopy Diameter (Meters)
Acer rubrum	1.4081
Ginkgo biloba	1.4520
Liquidambar styraciflua	1.2823
Platanus x acerifolia	1.4237
Prunus cerasifera	1.5517
Quercus palustris	1.9704
Quercus rubra	2.1769
Tilia americana	1.1364
Tilia cordata	0.4783
Tilia tomentosa	1.0351
Ulmus americana	2.8805
Zelkova serrata	1.5055
Celtis occidentalis	1.4577
Quercus macrocarpa	0.9963
Betula nigra	3.2416
Gleditsia triacanthos	1.7719
Gymnocladus dioicus	1.5443

Figure Source: OMB

The average for all final species is taken to yield an average new-street-tree canopy diameter of 1.61 meters used for all modeled tree planting. Species are determined based on historical and presently approved planting lists in consultation with the NYC Parks Department. While species choices may change over time, the city considers future conditions when determining their planting pallet and so the species included here are a best estimate of average future planting considering climate change.
Once the buffer totals for crown diameter are identified, the randomly assigned points are aggregated based on the year they are scheduled to be planted. Within the attribute table for the planting zones (which are carried onto the points layer when generated), there is a field that identifies the year in which the panting is slated to occur, from end-of-year 2024 to 2035. Each year is isolated from the planting group by attribute using the Select by Form tool in QGIS. The average crown diameter is applied via a buffer of the 17 tree species (1.61 meters) is applied to each point within the planting

zones. Based on planting year, buffered trees are “grown” after they are “planted” using the Fixed Percentage Buffer tool in QGIS to simulate growth to the decadal intervals used in the analysis.

Limitations

Tree canopy is just one adaptation measure for outdoor heat. In the future, other work could be considered, such as light-colored surfaces. Furthermore, only street tree planting plans (and all tree expansion) is included, though private property and non-street city trees’ planting will be part of the cooling strategy.

COASTAL FLOODING FORECAST

How does the forecast evaluate local flooding from storm-surge and sea-level rise?

The forecast focuses on the potential for reducing flooding, or the *flood attenuation* potential, for present and future conditions. It specifically looks at select large-scale, neighborhood-level coastal flood protective projects under high-tide and storm-surge (with SLR) conditions given anticipated flood protection projects, both with and without the U.S. Army Corps of Engineers (USACE) New York and New Jersey Harbor and Tributaries Focus Area Feasibility Study (NYNJHATS) projects as per their 2022 Tentatively Selected Plan.[118] See the table below for the scenarios described in this section. These large-scale projects are just one form of protection, and this analysis is not a determination that these are the best option for coastal flood protections—the forms of these coastal protections do not show effects of individual building protections, Building Code Appendix G flood-resistant construction requirements, use of the CRDG, community resilience, or other protective options.

FIGURE | FLOOD AREAS USED FOR DECADAL FORECAST

Federal Benchmark	**2020s Present/Current**	**2030s**	**2050s**	
Storm Surge+SLR CBFY26	FIRM/PFIRM	NPCC3 2020s storm	[no data]	NPCC3 2050s storm
Storm Surge+SLR CBFY27	FIRM/PFIRM	NPCC3 2020s storm	NPCC4 new 2030s storm	NPCC4 new 2050s storm
Tidal CBFY26	n/a	NPCC3 2020s tidal	[no data]	NPCC3 2050s tidal
Tidal CBFY27	n/a	NPCC3 2020s tidal	NPCC3 2020s tidal*	NPCC4 2050s tidal

*FY27 CB3 uses NPCC4 storm surge and tidal flooding with the 90th percentile projections. FY26 CB2 used NPCC3 75th percentile, but these are now updated to the best available data. Differences between NPCC3 75th and 90th percentiles are not substantial.

The NYNJHATS project portfolio is evaluated in separate scenarios (one with it and one without) because it is a large-scale initiative that could impact the whole city but is tentative at this time. While NYNJHATS is not itself a Planned Action, it is a large-scale, federally led project suite that would likely involve city cost sharing and planning should it proceed. In 2022, USACE released a Tentatively Selected Plan (TSP), which is still subject to study, finalization, and congressional approval. The TSP is likely to change, given that it is subject to new parameters as laid out in the Water Resources Development Act, new agency specific procedures, and that public comments are still being considered.[119] Until these steps are completed, it is not possible to know if the projects will proceed and the exact level of anticipated protection. Given the vast scope of this project set and the uncertainty, it is treated as a separate scenario in future coastal flood projections.

FIGURE | PROCESS FOR COASTAL FLOODING FORECAST

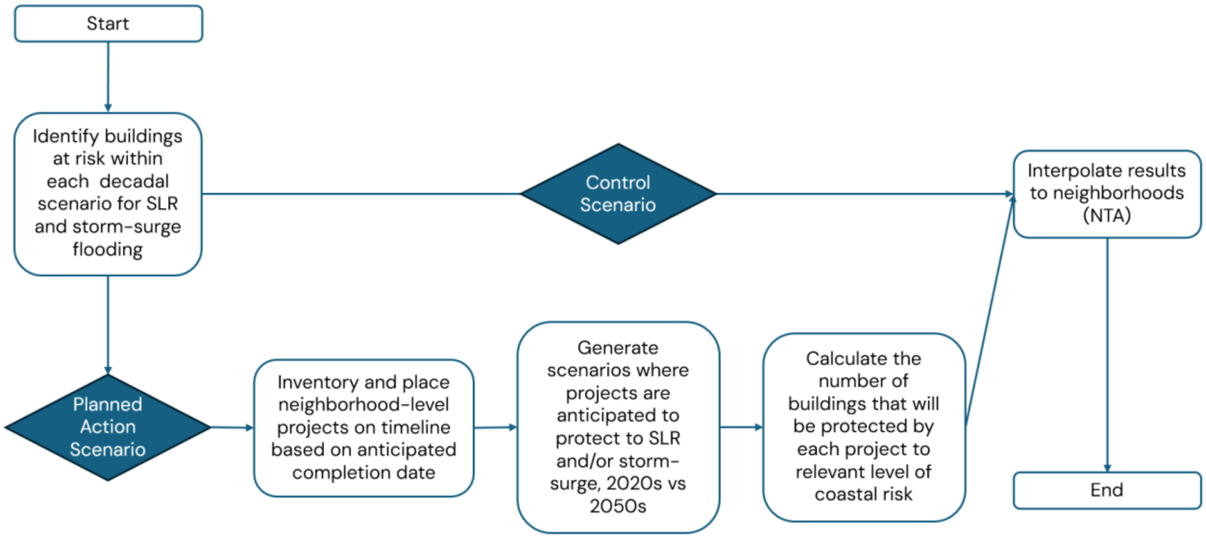

Figure Source: OMB

Parameters

- **Decadal Flood Areas:** The 100-year floodplain in this case describes the 1 percent annual-chance coastal flood for the specified decadal period (e.g., present-day 1 percent annual-chance flood; 2050s 1 percent chance flood). The city's Flood Hazard Mapper uses high estimates of SLR (90th percentile) to generate these storm-surge projections.[120] This is used in these analyses for consistency. For tidal flooding on its own (chronic flooding without storm-surge), a middle-high SLR estimate (75th percentile) is used to be conservative and consistent with the projection choices for outdoor heat (see previous sections). Note that this may be inconsistent with other guidance, such as the CRDG, but for the purpose of these illustrative projections is still appropriate for conducting comparable adaptation assessments, where as the CRDG are for proactive project development. However, this does shed light on the need for consistent guidance across the city on which projections to use and under what circumstances. This will be investigated further in the future

- **Sources of Projections**:

    - Present Day: The present-day tidal flood area uses the 2020s high-tide flood area (provided by NPCC) because no present-day, widely accepted flood map exists for tidal flooding in the city. Note that the same map is used for present-day and 2020s flooding. Present-day storm-surge uses the combined FEMA FIRMs and PFIRMs, since they are not reconciled to one predominant map[121] This is consistent with guidance from the DOB that uses both maps to determine flood areas (most inclusive) in Appendix G of the city's codes.[122]
    - Future: NPCC provides projections to estimate changes in tidal and storm-surge floodplains. The analysis described below relies on the 100-year floodplain (1 percent annual-chance flood) and high-tide flooding areas.[123]
- **Projections Used**: All current coastal flooding projections are based on NPCC4 (2024).

As localized NPCC4 projections become available, they may be incorporated into analysis. OMB aims to use the most up-to-date NPCC projections. NPCC3 reaffirmed the projections from NPCC2 (2015).

FIGURE | DIFFERENCES BETWEEN PROJECTIONS (10^{TH}, 25^{TH}, 75^{TH}, 90^{TH} PERCENTILES)

(inches)	2020s	2030s	2050s	2080s	2100
NPCC2/3[124]	2, 4, 8, 10	--	8, 11, 21, 30	13, 18, 39, 58	15, 22, 50, 75
NPCC4[125]	--	6, 7, 11, 13	12, 14, 19, 23	21, 25, 39, 45	25, 30, 50, 65

For information on how the control scenario was developed and building counts were assigned, please see the FY26 Climate Budgeting Publication Technical Appendices.

Future Decades

For analysis of future decades, NPCC flood maps for the 2030s and 2050s decadal periods are used and the DOB Building Footprints Feature Layer is overlaid on these flood hazard maps to determine how many buildings (by BIN) fall within the projected floodplains. This assumes no change in building count and location into the future. Projecting these changes can be investigated in the future.

The table, available in the FY26 Executive Budget Climate Budgeting Publication's Technical Appendix, shows the number of buildings located within the flood area for the present and future high tide and 100-year storm for each NTA, without neighborhood-level protections. This is what is considered the "buildings at-risk." NTAs without any floodplain overlap or any buildings are excluded from this list. This is not a comprehensive list of every neighborhood in the city—it only includes NTAs that have at least one building at risk of either storm-surge or tidal inundation.

Planned Action Scenario

How many buildings will remain at risk of flooding if large-scale infrastructure projects are built?

The Planned Action Scenario builds on the Control Scenario, adding in levels of protection for selected coastal resiliency projects. To do this, the key steps are:

1. Identify which city projects may reduce risks from tidal flooding and the 100-year storm
2. Gather data for each project, including design storm level (see below), project extent maps, and corresponding floodplain reductions
3. Join all project data and overlay with city building locations to understand what properties may be protected after interventions are implemented

Coastal Project Delineation

Flood resiliency projects are built to different levels of protection, such as present-day SLR, 2050s 100-year storm, 2030s 10-year storm, and others. The intensity, duration, and frequency of storm event an asset is designed to withstand is known as the "design storm."[126] To build to a particular design storm, and based on the conditions of a given site (e.g., elevation), the height of a large flood protective measure are typically referred to be the "design flood elevation." The choice to build protections at varying levels is made by the project design teams, which consider factors like site conditions, available funding, specific needs, and other relevant information. Only the scenarios included in the beginning of this section (1 percent storm-surge (with SLR) and high tide for present, 2020s, and 2050s) are included this analysis. More information on this process can be located in the FY26 Climate Budgeting Publication Technical Appendices.

Coastal Project Selection

OMB worked with DEP BCR, NYCEDC, and MOCEJ to identify neighborhood-level resiliency projects that should be included in the analysis, as well as DDC, Battery Park City Authority, NYS Department of Housing and Community Renewal, USACE, and the NYC Parks Department regarding projects under their management and control. See the table below for the final project list for the 15 projects that are modeled after the collection process and review.

FIGURE | LIST OF COASTAL PROTECTION PROJECTS CONSIDERED IN FORECAST

East Side Coastal Resiliency	Seaport Coastal Resilience	East Midtown Coastal Resiliency
Brooklyn Bridge-Montgomery Coastal Resilience	FiDi-Seaport Climate Resilience Plan	Mott Basin Raised Shoreline
Battery Park City Coastal Resilience North/West	Red Hook Coastal Resiliency	Rockaways Atlantic Shorefront (USACE)
Battery Park City Coastal Resilience South	Travis Avenue Raised Shoreline	Old Howard Beach Raised Shoreline
The Battery Coastal Resilience	South Shore of Staten Island Coastal Storm Risk Management (USACE)	NYNJHATS (USACE)

Figure Source: OMB

For a list showing projects that were evaluated but do not meet the selection criteria for this first iteration of analysis (e.g., protecting assets rather than neighborhoods, data availability at present project stage), please refer to the FY26 Climate Budgeting Publication Technical Appendices.

Coastal Project Processing

Input data sources included:

- DOB Buildings Footprints by BIN

- NYCEDC, DEP, and other agency project maps
- NPCC 2050s storm floodplain (100-year) and high tide flood area
- FEMA FIRM and PFIRM shapefiles

QGIS is used to find the attenuation extents for each coastal project (the area of floodplain behind each project that would see reduced flooding due to the project) and buildings protected during analysis (the number of buildings in the previously at-risk area that would now be in an area of managed risk from the flood project). For most projects, maps with flood attenuation areas are shared with OMB from project teams and shapefiles are included directly in the combined shapefile of project attenuation extents (output). Spatial data for some projects provided to OMB are only available as lines, not polygons. For these projects, OMB assumed attenuation areas for the project (looking at the area behind/upland of the barrier lines) for each of the scenarios separately (present tidal, future tidal without NYNJHATS, future tidal with NYNJHATS, present storm, future storm without NYNJHATS, and future tidal with NYNJHATS). This is only the case for the Raised Shoreline projects (Mott Basin, Old Howard Beach, Travis Avenue) and East Midtown Coastal Resiliency.

For the case of the Raised Shoreline projects, tidal flooding areas are assumed to be the extents upland of the proposed project lines, with flooded areas choked off by the barriers. For East Midtown Coastal Resiliency, the 100-year floodplain and tidal inundation areas are assumed to be entirely mitigated behind the barrier lines parallel to the tie-ins mapped.

Projects are phased in based on their completion year and the year of projection based on available NPCC projections (2020s and 2050s). For example, projects completed in the 2030s would not be included in the protected areas to the 2020s storm since they would not yet be built. Dates are estimations of completion dates and may differ as projects progress, including if projects are completed in phases. NYNJHATS is still tentative, as well. The latest dates are used to be conservative

Due to variations in flood modeling by various project teams and at different time points, projects that are listed as being built to withstand the 100-year storm in the present or the future are matched up to the utilized floodplains (FIRM/PFIRM and NPCC) and all appropriate areas considered to be attenuated. Where shared mapped attenuation areas vary slightly compared to the used floodplains, these are adjusted after consultation with project teams to allow for direct comparison between baseline flood maps and attenuated areas.

The same exercise is conducted for tidal flooding areas, but due to the lack of mapped tidal flooding attenuation areas available, tidal attenuation areas are largely extrapolated based on the storm attenuation area if applicable in the tidal zone. See the table below for information on each project's scenario inclusion. For example, if a project's design storm is the present-day 10-year storm and 2100 SLR flooding, this would have been incorporated into the protection area analyses as such:

- Present Tidal: yes

- Present Storm: no (not built to a high-enough standard to protect fully against the 100-year storm)
- Future Tidal: yes
- Future Storm: no (not built to a high-enough standard to protect fully against the 100-year storm)

A final list of selected projects with their associated attenuation extents are available in the FY26 Climate Budgeting Publication Technical Appendices.

Notably, partial protections are not considered in these analyses due to complexity. While it may be the case that a barrier for the 10-year design storm provides some protection to the 100-year storm (though not full protection), only full protections for each scenario are included.

Additionally, though a year's storm-surge (including SLR) is greater than tidal flooding alone, not all storm-surge projects are protective to tidal flooding. For example, some projects use deployable barriers that are only deployed when a threshold storm event is reached—these would not be deployed during high tides alone and would thus remain exposed unless other complementary measures are included in the project. The one exception for this evaluation is NYNJHATS—NYNJHATS includes some High Frequency Flood Risk Reduction Features that are used to ameliorate risk for lesser events when storm-surge deployables are undeployed. For this reason and due to the uncertainty of the project at this stage, NYNJHATS-inclusive scenarios consider all protected areas for storms to be protected for tidal flooding, as well, though this may not always be the case in practice.

After project areas are corrected, the count of buildings in the floodplain per NTA are generated using QGIS Count Points within Polygons function. This is based off attenuated areas behind the flood barriers, where flooding would occur without the barrier and would likely not occur to that design level with the barrier installed. The count of buildings in the attenuation floodplain area are generated and these values compared to the total number of at-risk (in the floodplain) buildings to generate a proportion of potentially protected buildings for each scenario per NTA. See the table below for the share of buildings in each scenario that would be protected from the proposed projects. Note that only the NTAs that overlap the floodplain are eligible for analysis and the results are a simple proportion—if the neighborhood expects a flood wall for example that will protect 100 percent of buildings in two NTAs behind it, the pertinent NTAs would see 100-percent protection. This is equal for an NTA with five out of five protected properties and an NTA with 100 out of 100 protected properties, since showing proportions of protection. This is not a comprehensive list of every neighborhood in the city—it only includes NTAs that have at least one building protected by a neighborhood-scale project from either storm-surge or tidal inundation. The list is available on the OMB Landing Page, under Climate Budgeting.

Additional Limitations

Projects will come online incrementally, with levels of protection adding up over time, though the gulf of time between the 2020s and 2050s scenarios may make the onset of protections seem sudden in forecast results for these two decadal periods. Furthermore, project design levels are only as good as their scientific design criteria. If climate change progresses more rapidly, events such as tidal flooding and any 100-year storm are likely to become more frequent and extensive, which can lead to underperformance of protective measures.

While neighborhood-level protective measures are important, redundant protections and community and social measures can provide higher levels of protection, such as during the event of failure of a large flood protection project (e.g., a breach or damage). Analysis in the future will attempt to add these in a standardized way to existing efforts and update with projects that are cancelled or newly planned.

Additionally, projects in this list mainly include large hardscape designs, though may include some nature-based solutions within larger projects. These and other natural features such as wetlands will be investigated more in the future. The evaluation of hardscape measures such as floodwalls currently does not include analysis of induced flooding (flooding in a place that results from or worsens due to flood protections in a nearby place. Some project designs may include induced flooding-reduction features, but these are not separately captured in this analysis and may be investigated in the future.

Projects that are included on this list are likely to be completed and some are already complete or almost complete. Projects may be added, altered, or removed from the forecasting list and analyses will be updated in the future to account for project status and design changes and should be considered a potential view of protection, not a certainty.

Only building counts are included in this first analysis, but more could be assessed, such as number of residential units, number of buildings of different types (e.g., critical facilities), infrastructure, property value, demographic populations, and others. These would be more important for understanding the nuanced impacts of different at-risk populations and assets. Furthermore, the number of buildings will vary in the future, but due to the lack of a granular buildings count forecast citywide, baseline building counts are projected forward into the future for the purposes of assessing levels of adaptation to buildings.

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The City of New York
Executive Budget
Fiscal Year 2027

Zohran Kwame Mamdani, Mayor

Mayor's Office of Management and Budget
Sherif Soliman, Director

Technical Appendix C: Greenhouse Gas Emissions and Air Quality Forecasting

New York City Climate Budgeting

CONTENTS

This technical appendix provides additional detail on the methodology, assumptions, and key inputs used to develop the city's sustainability analysis, including the citywide greenhouse gas emissions forecast.

The overall forecasting framework remains consistent with prior years and is described in detail in the FY 2026 Technical Appendix. This appendix focuses on updates for FY 2027, including an electricity-sector uncertainty analysis, updates to modeled city actions, including the addition of the Affordable Housing Reinvestment Fund, and a utility return on equity analysis.

EMISSIONS FORECASTS

The citywide greenhouse gas emissions forecast is highly sensitive to assumptions about future electricity emissions, and New York State's timeline for decarbonizing the electric grid serving New York City is unclear. To evaluate this uncertainty, OMB tested alternative electricity-sector pathways in the U.S. Environmental Protection Agency's City-based Optimization Model for Energy Technologies (COMET). COMET allows the city to develop energy, environment, and economic forecasts through 2050 and provides long-term prospects for practical and applicable energy policy solutions. In its forecasting, COMET projects the lowest-cost mix of fuels and energy technologies necessary to meet the demand for energy and transportation.

In this analysis, COMET is used to project the electricity-sector emissions trajectories that feed into the citywide forecast and to test how different grid decarbonization assumptions affect projected citywide emissions over time. Only electricity-sector assumptions vary across scenarios. All non-electricity assumptions, including baseline demand, direct fossil fuel use, and modeled city actions, are held constant.

OMB developed three electricity cases: a primary forecast, an intermediate forecast, and a conservative forecast. Figure 1 shows these forecasts. These cases differ along two dimensions. First, they vary in the pace at which new clean electricity resources can be deployed. Second, they vary in the extent to which fossil fuel generation remains available after 2040. The analysis is intended to isolate the effect of uncertainty in grid decarbonization on projected citywide emissions. It is not intended to represent three separate economy-wide policy scenarios.

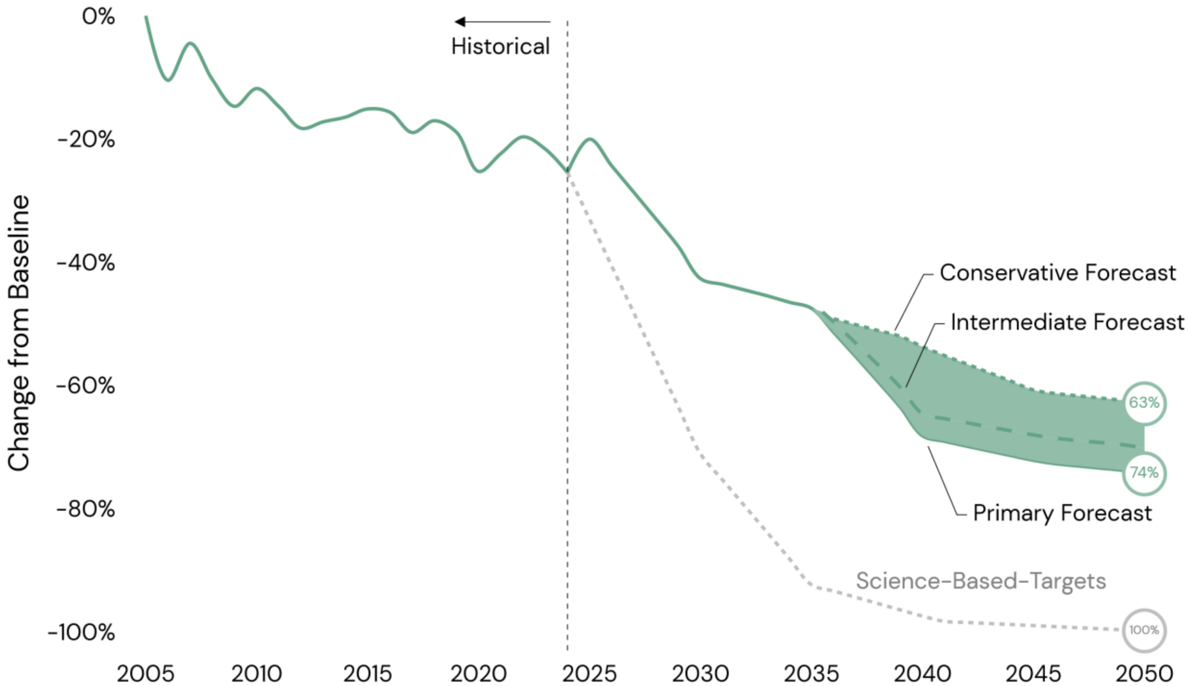

FIGURE 1. SENSITIVITY OF PROJECTED CITYWIDE GREENHOUSE GAS EMISSIONS REDUCTIONS TO ALTERNATIVE ELECTRICITY-SECTOR ASSUMPTIONS

The primary forecast is the basis for the main citywide projection shown in the publication. It assumes no additional constraints on clean electricity deployment beyond those embedded in the standard COMET module and retains fossil fuel limits consistent with the modeled Climate Leadership and Community Protection Act (CLCPA) pathway. This produces the most rapid decline in electricity-sector emissions.

The intermediate forecast holds the pace of clean resource deployment constant relative to the primary forecast, but relaxes the treatment of fossil generation after 2040. Specifically, this case removes limits on fossil fuel flows after 2040 and removes limits on fossil fuel generating capacity. This allows fossil generation to remain available later into the forecast period even though renewable generation and storage are still able to expand without additional build-rate limits. The intermediate forecast therefore isolates the effect of a slower fossil fuel phaseout while holding the pace of clean electricity deployment unchanged.

The conservative forecast combines slower clean resource deployment with the same relaxed post-2040 fossil fuel assumptions used in the intermediate forecast. In this case, the model applies upper bounds on the amount of new solar and wind capacity that can be added in each five-year period and also applies an upper bound on the amount of new hydro capacity that can be added. These constraints are intended to reflect a more limited pace of clean electricity buildout. At the same time, fossil fuel flows and fossil fuel generating capacity remain unconstrained after 2040. The conservative forecast therefore produces the slowest decline in electricity-sector emissions of the three cases.

Together, these cases define a bounded range of electricity-sector outcomes. Because all non-electricity assumptions are held constant, differences across scenarios reflect only uncertainty associated with grid decarbonization.

The purpose of this analysis is to test the sensitivity of the citywide forecast to uncertainty in future grid emissions intensity. It does not change modeled assumptions for city policies, city government operations, direct fossil fuel use in buildings, transportation demand, or waste sector emissions outside the electricity pathway. This approach allows OMB to evaluate how differences in the timing and extent of grid decarbonization affect overall citywide greenhouse gas outcomes while keeping the rest of the forecast structure unchanged.

Forecast	Descriptive summary	Key distinguishing assumptions
Primary	Faster grid decarbonization	No additional clean build-rate limits; fossil fuel constraints retained
Intermediate	Slower fossil fuel phaseout	No additional clean build-rate limits; fossil fuel flow and capacity limits removed after 2040
Conservative	Slower clean buildout and slower fossil fuel phaseout	Solar, wind, and hydro buildout constrained; fossil fuel flow and capacity limits removed after 2040

TABLE 1. SCENARIO STRUCTURE SUMMARY

OMB selected these scenario dimensions because they capture two of the most consequential sources of uncertainty in the electricity-sector pathway used by the citywide forecast.

First, the rate at which new renewable and other clean electricity resources can be brought online affects how quickly grid emissions decline. In practice, this pace depends on permitting, interconnection, supply chains, labor availability, transmission readiness, financing conditions, and technology deployment constraints. The conservative forecast reflects this uncertainty by imposing upper bounds on new solar, wind, and hydro additions in each model period.

Second, the treatment of fossil generation after 2040 affects whether residual fossil generation remains available in the modeled system even as clean resources expand. The intermediate and conservative forecasts test this uncertainty by removing post-2040 limits on fossil fuel flows and fossil fuel generating capacity. This allows the model to retain greater fossil generation availability in later years than in the primary forecast.

Together, these dimensions provide a structured way to test whether the citywide forecast remains robust under slower clean electricity deployment and less complete fossil fuel phaseout.

GRID EMISSIONS FACTORS BY SCENARIO

To support the electricity-sector scenario analysis, Table 2 reports the grid carbon dioxide emissions factors generated by COMET for each forecast scenario. These values represent the modeled carbon intensity of electricity used in the citywide forecast and are expressed in kilograms of carbon dioxide equivalent per kilowatt-hour of electricity consumed. OMB applies these scenario-specific electricity emissions factors to projected electricity consumption in the citywide forecast to estimate indirect emissions from electricity use in each year.

Across all three scenarios, grid emissions intensity declines substantially between 2025 and 2050, but the timing and extent of those declines vary across cases. In the primary forecast, electricity emissions intensity declines most rapidly, reaching near-zero levels by 2040 and remaining near zero thereafter; this reflects a modeled outcome in which the state meets the CLCPA's electricity-sector targets by 2040. The intermediate forecast also shows substantial decarbonization, but retains a higher residual emissions intensity after 2040. The conservative forecast produces the slowest decline in grid emissions intensity and the highest electricity emissions factors in the later years of the forecast period. These differences are a major source of divergence across the three citywide greenhouse gas forecast paths.

	Scenario		
Year	Conservative	Intermediate	Primary
2025	0.37985	0.37877	0.38163
2030	0.19724	0.20248	0.20370
2035	0.18590	0.20863	0.19696
2040	0.13684	0.06849	0.00633
2045	0.09402	0.07005	0.00582
2050	0.08900	0.07265	0.00553

TABLE 2. COMET GRID CARBON DIOXIDE EQUIVALENT EMISSIONS FACTORS BY SCENARIO ($KGCO_2E/KWH$)

CITY ACTIONS

Policies and commitments made by the city remain among the main drivers of forecasted greenhouse gas emissions reductions. OMB includes in the forecast city actions that are expected to meaningfully impact emissions, are committed through local legislation, mayoral commitment, or executive order, and are funded in the budget or capital plan or will be carried out by mayor-appointed leadership.

For FY 2027, OMB updated the city actions analysis to reflect the current set of major city-led emissions reduction measures and revised assumptions for existing actions. The modeled actions span buildings, transportation, and waste, and include regulatory requirements, direct public investment, operational changes, and programs that support private-sector decarbonization. The full set of actions and their forecasted impacts is shown in Table 3.

City Action	2050 Emissions Reductions (tCO_2e) (FY 2026)	2050 Emissions Reductions (tCO_2e) (FY 2027)
Building Emissions Limits	-2,011,360	-1,630,350
Efficient & Electric New Builds	-423,580	-423,960
For-Hire Vehicle Electrification	-424,260	-318,530
J-51 Reform	-294,070	-302,000
City Government Operations	-338,270	-180,560
Fuel Oil Phase-Out Mandates	-127,280	-115,090
NYCHA Clean Heat For All Challenge	-209,190	-112,010
School Bus Electrification	-90,790	-91,380
HPD Sustainability Design Guidelines	-17,780	-64,410
Electric Vehicle Vision	-30,730	-22,970
Mandatory Citywide Curbside Organics Collection	-11,210	-12,530
Affordable Housing Reinvestment Fund	-	-5,140
Bike Lanes	-480	-400
Bus Lanes	-220	-170
NYCHA Solar Installations	-100	-160
Public Solar NYC	-50	-40

TABLE 3. EMISSIONS REDUCTIONS FROM CITY ACTIONS

As in prior forecast iterations, the expected reductions are concentrated in a relatively small number of high-impact actions. Figure 2 shows that building-sector measures continue to account for the largest share of projected city-action reductions in 2050, led by Building Emissions Limits. Transportation measures, especially for-hire vehicle electrification, also account for a substantial share. The remaining actions are smaller individually, but together contribute meaningful additional reductions across sectors and expand the city's overall emissions reduction strategy. Changes in estimated emissions reductions reflect updated assumptions about program scale, timing, and implementation based on the most recent available data.

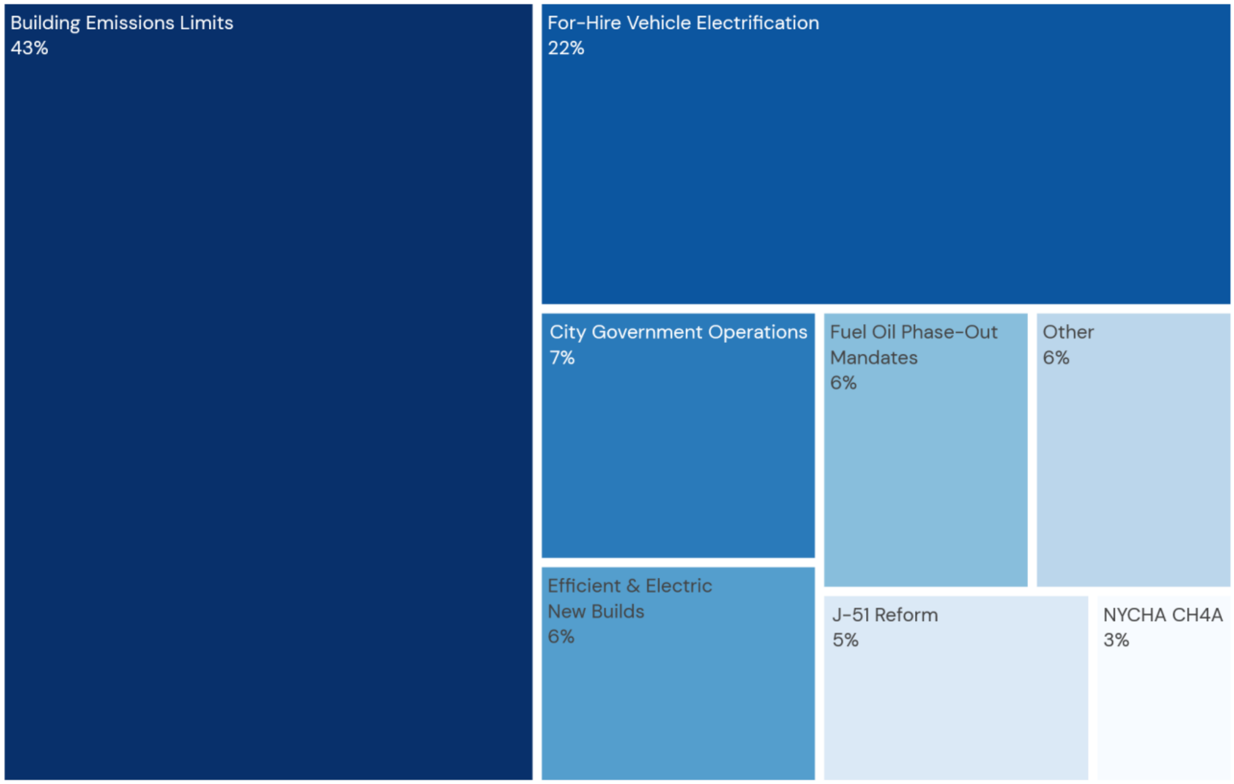

FIGURE 2. RELATIVE EMISSIONS REDUCTIONS FROM CITY ACTIONS IN 2050

Affordable Housing Reinvestment Fund

Criteria Screening for New City Actions

1. GHG Impact: 59,000 tCO_2e saved cumulatively through 2050
2. Commitment: This is the program by which properties can purchase carbon offsets for a portion of their LL97 emissions reduction targets. Each credit purchased is used to fund electrification retrofits in affordable housing within New York City.
3. Responsibility: Carried out by New York City Housing Preservation & Development (HPD), in conjunction with the New York City Energy Efficiency Corporation (NYCEEC)

Context

In 2025, New York City launched the AHRF as a compliance option for properties facing Local Law 97 of 2019 (LL97) emissions limits. Properties may offset up to 10% of their emissions limit through the purchase of AHRF credits. Credits cost $268 (equal to the LL97 penalty) and are certified so that the purchase of one credit removes one ton of carbon dioxide equivalent over twenty years (Urban Green Council 2025). These emissions reductions occur by funding electrification of fossil-fuel powered heating systems in New York City affordable housing.

OMB estimated the GHG impact of the AHRF by modeling the projected demand for offset credits, based on the actual purchases during the first year of the program and projections in building emissions from the LL97 model. We assume that, among Article 320 properties, the same proportion of properties will purchase AHRF offsets as in the historical data. After segregating by ownership type (condo/co-op, rentals, and non-residential), we use the average percentage of potential offsets purchased and the projected LL97 emissions to project the amount of offsets purchased in each year as follows:

$$Offsets_{year=t} = Offsets_{year=2024} \frac{\min\left(EmissionsLimit_{year=t} \cdot 0.1,\ EmissionsExceedance_{year=t}\right)}{\min\left(EmissionsLimit_{year=2024} \cdot 0.1,\ EmissionsExceedance_{year=2024}\right)}$$

Once an offset is purchased, the next step is how to calculate the change in fuel consumption corresponding to the emissions reduction. The amount of fossil fuel replaced by electric heating will change over time as the emissions factor changes. Then, to find the amount of fossil fuel consumption reduction per year needed to reach 1 ton reduction over 20 years, we solve the following equation:

$$1 = \sum_{1}^{20} x\ EF_{Fossil\ Fuel} - x\ \frac{EFF_{Fossil\ Heat}}{EFF_{Electric\ Heat}} EF_{Electricity,year=t}$$

Where x is the MMBtu of fossil fuel reduction, EF denotes emissions factor and EFF denotes efficiency. We assume that, for program determination, emissions factors for electricity are the same as those used to set LL97 rules (with linear interpolation between compliance periods). We assume that each unit of fossil fuel consumption removed has efficiency 0.8, and that the efficient electric heating that replaces this consumption has efficiency 2.4 (from LL97 model average parameters).

We then project forward these fossil fuel and electric consumption changes, assuming that all systems (once installed) last through the end of the forecast period.

UTILITY RETURN ON EQUITY ANALYSIS

Excessive utility return on equity (ROE) drives up the price of energy and cost of living. As regulated monopolies, the ROE (or profit rate) of investor-owned utilities is set during the rate case process led by the State's Public Service Commission (PSC), rather than by a competitive market. According to legal precedent, ROE should be set at the utilities' cost of capital (*FPC v. Hope Nat. Gas Co.* 1944; *Bluefield Water Works & Improvement Co. v. Public Service Commission of West Virginia* 1923). However, a growing body of research shows that ROE exceeds reasonable levels across North America. OMB has analyzed historical data to determine utilities' appropriate cost of capital, concluding that ROE in New York State is roughly 50% above reasonable levels. Setting utility ROE at appropriate levels would reduce overall utility bills by roughly 4% in New York City, resulting in over $1 billion in annual savings.

Excess ROE exacerbates energy costs without improving the performance of the energy system. ROE makes up roughly 20% of delivery charges in New York City, or 10% of the total gas and electric bills. Figure 3 below shows the breakdown for the most recent Consolidated Edison (ConEd) electric accounting panel information. Some ROE is necessary to attract private investment, which is required to maintain and improve energy infrastructure. However, ROE exceeding the cost of capital serves no purpose for the energy infrastructure and simply acts as a transfer of wealth from ratepayers to utility shareholders.

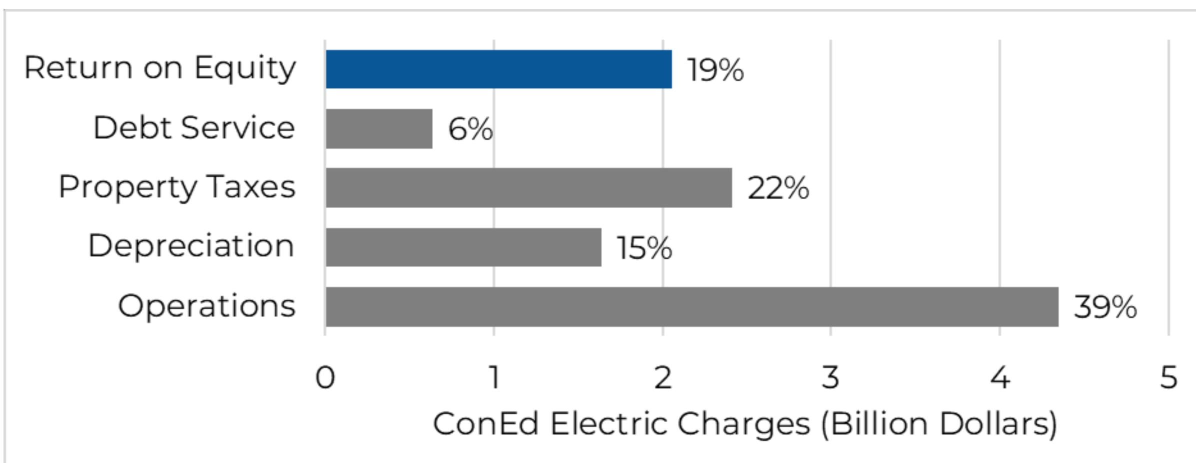

FIGURE 3. COST BREAKDOWN OF CON ED DELIVERY CHARGES

High ROE encourages utilities to increase their capital expenses in the long run because ROE is a percentage of the utility's capital expenses. For example, an electric utility facing capacity constraints may find it more profitable to invest in new substations or transmission infrastructure (capital expenses) to accommodate additional demand rather than energy efficiency programs (operational expenses) to reduce demand. Empirical evidence finds that each one percentage point increase in ROE corresponds to a 5% increase in new capital investment (Dunkle Werner and Jarvis 2025).

A growing body of evidence demonstrates that utility ROE is far higher than utilities' cost of capital across North America. A fundamental principle of finance is that investors should be compensated for taking on risk. As monopolies selling essential products with strong cost recovery mechanisms, regulated utilities' equity represents minimal investment risk. A 2019 analysis found that utilities earn 96% of their awarded ROE on average (Rode and Fischbeck 2019), making utility equity a very secure investment outside of exceptional circumstances such as wildfire-related liability for California utilities. Despite this, utility return on equity has exceeded average returns of many asset classes over the past several decades. Figure 4 below shows that ConEd's ROE has exceeded returns even from much riskier assets, including the S&P 500 and stocks of riskier small-cap companies. Academic research has found a growing gap between utility ROE and the returns of risk-free assets (Rode and Fischbeck 2019; Dunkle Werner and Jarvis 2025).

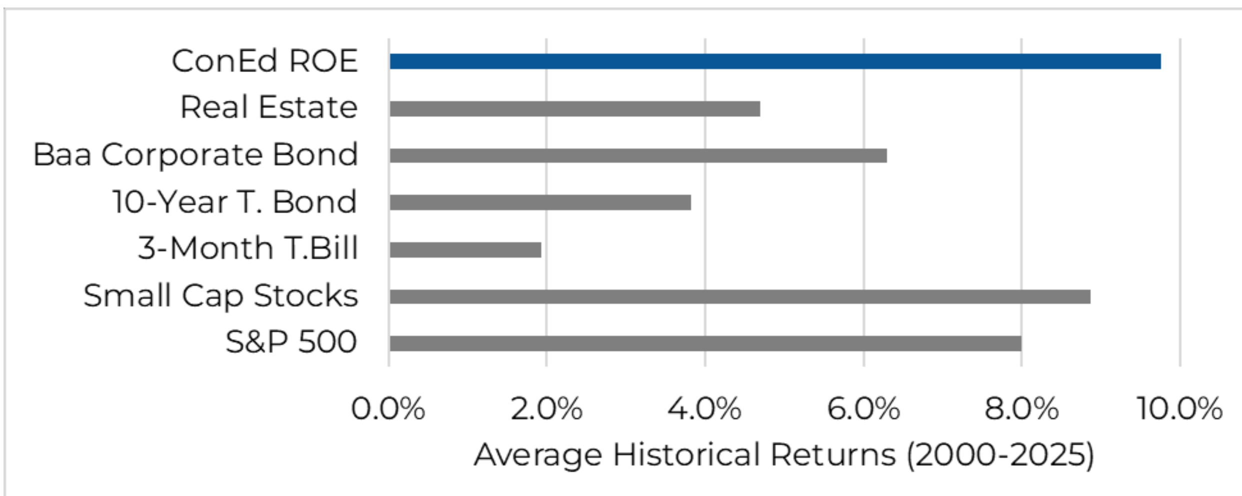

FIGURE 4. HISTORICAL RETURNS FROM VARIOUS ASSETS VERSUS CON ED ROE.

Setting ROE at an appropriate level, as determined by our analysis, would result in over $1 billion in annual savings for New York City and roughly $2 billion in annual savings across New York State. Figure 5 below shows the total ratepayer savings across New York State, for each gas and electric utility, that would result from lowering the ROE from the most recently awarded levels to 6.0%. Cost savings were determined using estimates of cost savings from each 10-basis point reduction in ROE, from New York State Department of Public Service testimony in each rate case.

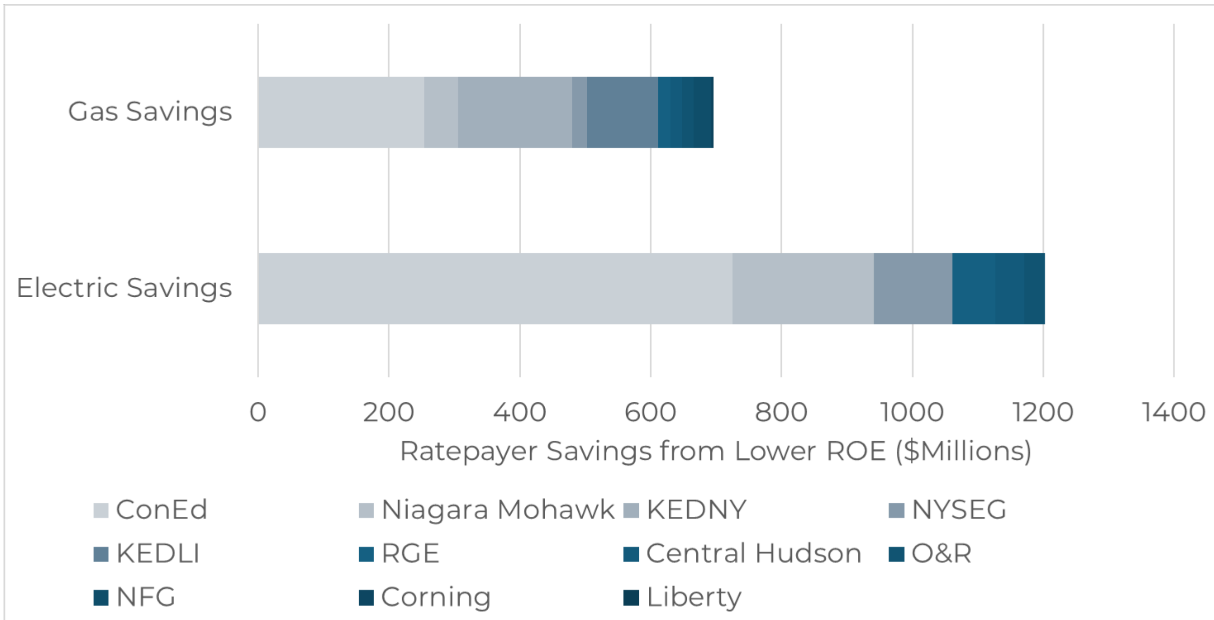

FIGURE 5. RATEPAYER SAVINGS FROM PROPOSED ROE ACROSS NEW YORK STATE

The remainder of this section describes existing ROE methodology used in New York State utility rate cases and adjustments to this methodology suggested by analysis of historical data. In New York State, ROE is calculated using a standardized process as illustrated in Figure 6 below. In this process, a Proxy Group of similar utility companies is first selected. Then for each company in the proxy group, two methods are used to estimate return on equity: discounted cash flow (DCF) and capital asset pricing model (CAPM). The overall return in equity is the weighted average of these estimates, placing twice as much weight on the DCF estimates as CAPM. There is considerable room for analyst interpretation of methodologies within this standardized ROE calculation approach.

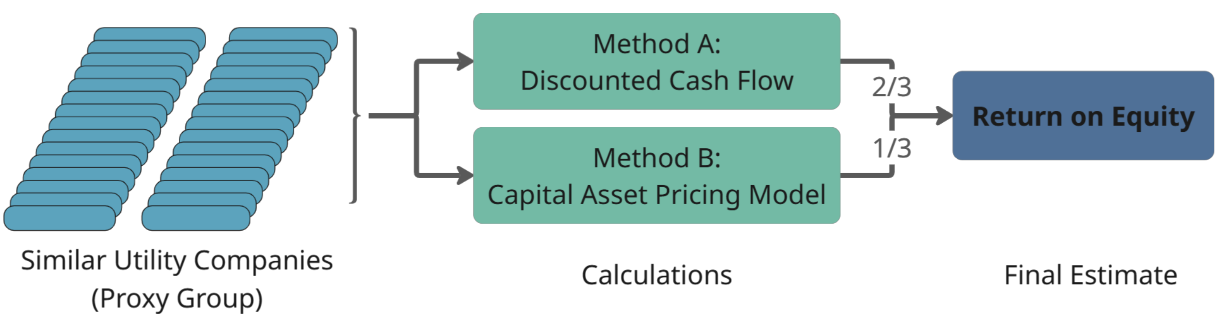

FIGURE 6. SCHEMATIC OF ROE CALCULATION

Common practices within this standard approach inflate ROE by assuming levels of growth inconsistent with historical performance. Analysis of historical stock performance contradicts three practices which collectively inflate ROE by over 50% in recent rate cases. First, the assumption that the long-term growth rate of utility dividends used in DCF will equal nominal gross domestic product (GDP) growth. Historical data shows that the utility dividend growth rate is significantly lower, closer to the rate of inflation or real GDP growth. Second, the use of a market risk premium calculated by aggregating analysts' company-level forecasts of stock performance. Evidence shows that this results in optimistically biased forecasts, and that instead the market risk premium should be calculated using an economy-wide growth estimate. And third, using weekly beta values adjusted towards one. Historical data show that this adjustment is not appropriate, and that if any adjustment is considered, it should be used to adjust raw beta values towards the historical utility-sector average rather than towards one. Each of these three practices are analyzed in more detail below.

Table 4 below summarizes these three corrections, as well as the savings for New York City ratepayers if these changes were adopted.

Assumption	Evidence	ROE Impact	Citywide Savings (Millions)
Utility dividends grow faster than GDP	Growth is about half as fast as GDP	-2.7%	$720
Analysts who sell stocks accurately predict long-term stock market growth	Analysts are biased; independent experts are more reliable	-0.9%	$260
Utility stocks will grow at same rate as market in the long term	Utility stocks grow at rate well below overall market	-0.4%	$120

TABLE 4. SUMMARIZING KEY POINTS OF ROE ANALYSIS

DISCOUNTED CASH FLOW

The DCF method infers cost of equity as the discount rate that would rationalize recent stock prices as the discounted sum of future cash flow. Multiple versions of this formula exist, including a simplified version that assumes that dividends will grow at a constant rate in perpetuity (Gordon and Shapiro 1956).

Regulators in New York State instead use a form where they rely on analysts' expected dividend growth rate for the near-term and a sustainable growth rate for the next 200 years. The cost of equity is learned by solving for r in the following equation:

$$p = \sum_{t=0}^{s} \frac{d_t}{(1 + r)^t} + \sum_{t=s+1}^{200} \frac{d_s \cdot (1 + g)^{t-s}}{(1 + r)^t}$$

Where p is the price of the equity; t is the year; s is the maximum year for which short-term analyst forecasts are available; r is the discount rate; d_t is the analysts' expected dividend in year t ; and g is the long-term growth rate.

Forecasting Dividend Growth

The long-term utility dividend growth rate is the key assumption in the DCF method. In the Gordon-Shapiro model, long-term growth is the only driving factor. In the multi-phase DCF methods used by

New York State regulators, the long-term growth rate is the single most important factor although the analyst-derived short-term growth rate also influences the result.

We project utility dividend growth using federal long-term forecasts of economic indicators and historical data on the relationship between utility dividend growth and those indicators. The long-term growth of utility dividends is a key component to the DCF methodology, which comprises 2/3 of total ROE in New York State's generic finance methodology. We use almost a century of historical data to assess how long-term utility dividend growth relates to growth of economic factors. We then use long-term forecasts of economic indicators from the U.S. Congressional Budget Office (CBO) and U.S. Energy Information Agency (EIA).

Historical data can shed light on which approaches to predict long-term utility dividend growth perform best. Analysts often project long-term utility dividend growth by assuming the relationship between utility dividend growth and economic indicators, then applying that assumption to forecast utility dividend growth based on a projection of those economic indicators. Assessing how well these assumptions behave on the historical data record is the most informative option available for projecting how well they will behave over the next two hundred years.

The Center for Research in Security Prices (CRSP) provides the most comprehensive record of dividend issuances, dating back to 1929. Dividend issuance data must be adjusted to account for changes in shares outstanding and filtered for regular issuances. The Fama French Data Library publishes processed data summaries of the CRSP data that apply these processing steps and aggregate data to the industry level, providing both equal-weighted and value-weighted averages (Fama and French 2023).

We study the relationship between dividend growth and several economic indicators: real GDP, nominal GDP, and consumer price index (CPI). Dividend growth may be associated with general economic performance (measured by GDP) or with inflation (measured by CPI). For all variables, we use historical data from the Federal Reserve Bank of St. Louis.

A visual inspection of GDP, CPI, and utility dividend growth suggests that utility dividends grow at a similar rate to CPI or real GDP but substantially below nominal GDP. Figure 7 below plots the value-weighted average dividend per share from Fama French, the equal weighted average among comparable utility companies to ConEd (as defined by the proxy group in their most recent rate case testimony), nominal GDP, real GDP, and CPI. This indicates that average utility dividend growth is similar to real GDP or CPI growth, although there is a considerable range among individual companies' returns among the proxy group.

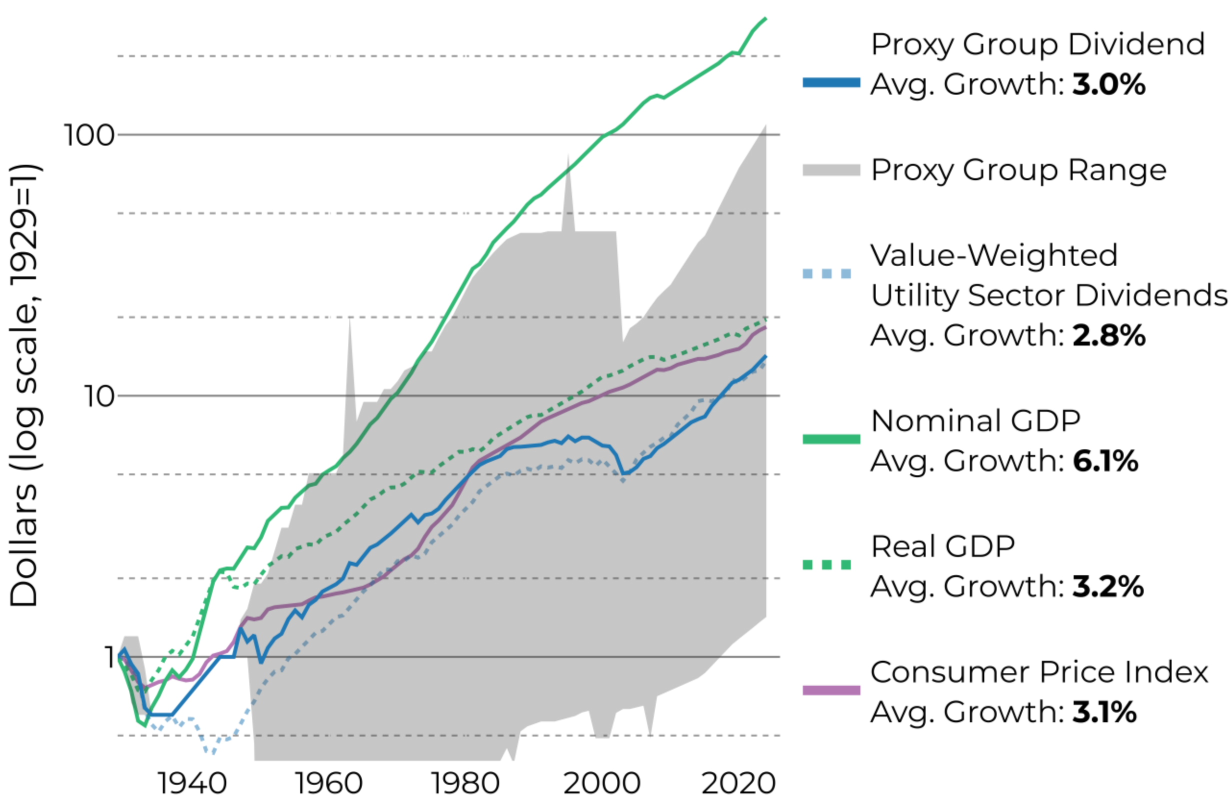

FIGURE 7. GROWTH OF UTILITY DIVIDENDS AND ECONOMIC INDICATORS

Regression analysis quantifies the correlation between these economic indicators and utility dividend growth, confirming the impression that growth is much slower than nominal GDP. Using log regression with company-level fixed effects, we learn the correlation between dividend growth and these economic indicators. Metrics are then evaluated on how well they predict utility dividends from companies in the proxy group from the recent Consolidated Edison rate case. To evaluate the performance of each metric at predicting utility dividends, we find the mean absolute percentage error (MAPE). MAPE is a useful performance indicator in this context because a percentage error is easily interpretable. Additionally, metrics such as R squared or root mean squared error would place more weight on recent values because economic indicators and dividends have all experienced a century of exponential growth.

The results of this analysis are shown in Table 5 below. Utility dividends are closely correlated with CPI and Real GDP growth, but substantially lower than the growth of nominal GDP. Predicting utility dividend growth by setting growth equal to nominal GDP growth (with no adjustment) yields an 84.6% MAPE. Assuming utility dividends grow at the same rate as nominal GDP results in double the error as using metrics such as CPI or real GDP. When adjusting utilities' growth rates to the correlation observed in historical data, MAPE decreases further. The lowest MAPE, or most accurate predictions, come from setting utility dividend growth rate at nominal GDP growth to the 42.8% power.

Indicator	MAPE Using Indicator with No Adjustment	Growth Correlation for Proxy Group	MAPE using Indicator Adjusted to Proxy Group Growth Correlation	Growth Correlation for Value-Weighted Average	MAPE using Indicator Adjusted to Value-Weighted Average Growth Correlation
CPI	40.40%	70.60%	35.20%	97.10%	39.30%
Real GDP	35.10%	89.20%	34.90%	104.10%	35.50%
Nominal GDP	84.60%	42.80%	34.30%	52.90%	36.00%

TABLE 5. MEAN AVERAGE PERCENT ERROR OF PREDICTING STOCK DIVIDENDS USING ECONOMIC INDICATORS

Now that we have determined that utility dividends grow at roughly the rate of inflation or real GDP, half the rate of nominal GDP, the next question is how to predict those economic indicators. There is substantial uncertainty in projecting economic growth into the distant future. However, by modeling well-understood trends in population growth and per-capita GDP growth, researchers can estimate the long-term economic performance.

The federal government publishes high-quality long-term GDP forecasts that should be used for this analysis. Both the EIA and CBO regularly publish long-term economic forecasts showing the predicted growth of the U.S. economy over the next several decades. Some private research firms also produce long-term economic forecasts. Perhaps the best known of these is S&P Global Market Research, which is used to inform the EIA's macroeconomic forecast model (Energy Information Agency 2025). CBO develops their own robust macroeconomic forecast, using methodologies honed over decades by their team of research economists (Congressional Budget Office 2025). These forecasts show that inflation is expected to stabilize in the long term, consistent with the goals of the U.S. Federal Reserve. Meanwhile, real GDP growth will continue a decades-long decline. This is consistent with a body of research forecasting decreased population and productivity growth (Congressional Budget Office 2026; Fernald et al. 2025; Antolin-Diaz et al. 2017).

Impact on ROE

With these forecasts in hand, we can develop a long-term growth forecast for utility dividends and evaluate the DCF model. Table 6 below shows the results using short-term analyst forecasts from Value Line (forecasts through 2029) and from Bloomberg (forecasts through 2035). Average stock values from the month of February 2026 and the most recent dividend forecasts available on March 1, 2026 are used. The calculated ROE ranges from 5.30% to 5.93% using Value Line forecasts, and 5.35% to 6.14% using Bloomberg forecasts, with an overall average value of 5.69%.

Short-Term Projection Source	Long-Term Projection Source	Metric	ROE (Nominal GDP)	ROE (Real GDP)	ROE (CPI)	Average ROE
Bloomberg	CBO	Mean	5.77%	5.64%	6.13%	5.85%
Bloomberg	CBO	Median	5.49%	5.35%	5.88%	5.57%

Bloomberg	EIA	Mean	5.89%	5.78%	6.14%	5.94%
Bloomberg	EIA	Median	5.62%	5.51%	5.89%	5.67%
Value Line	CBO	Mean	5.51%	5.37%	5.93%	5.60%
Value Line	CBO	Median	5.44%	5.30%	5.89%	5.54%
Value Line	EIA	Mean	5.64%	5.51%	5.91%	5.69%
Value Line	EIA	Median	5.57%	5.44%	5.86%	5.62%
		Average	**5.62%**	**5.49%**	**5.95%**	**5.69%**

TABLE 6. DCF ROE RESULTS

CAPITAL ASSET PRICING MODEL

The Capital Asset Pricing Model (CAPM) is a simple model that describes the required rate of return for an asset (Sharpe 1964). CAPM is based on modern portfolio theory, which assumes that investors build diversified portfolios that leave only systemic investment risk (eliminating idiosyncratic or asset-specific risk). In this portfolio theory, the required rate of return for any asset can be given by its correlation with the overall market (β), the risk-free rate (R_f), and the market rate of return (R_m) :

$$ROE_{CAPM} = R_f + \beta(R_m - R_f)$$

CAPM is widely used by financial practitioners. Model outputs confirm basic financial guidelines: investors require higher returns during periods of market volatility, when R_m is higher, or for higher-risk (higher-beta) investments.

One key implication of the CAPM model is that the same market should be used to compute market risk and betas. If beta is measured relative to a different reference market than the market risk premium, the term $\beta(R_m - R_f)$ will not capture the share of market risk premium that can be expected from the target equity.

Market Risk Premium

Market risk premium (MRP) is the expected return from the overall market, or the difference between market return and the risk-free rate: $R_m - R_f$. MRP has a large influence on the CAPM ROE, which is the sum of the risk-free rate and the product of MRP and beta. Reasonable estimation of MRP is therefore crucial to correct CAPM.

MRP for determining ROE should be calculated using discounted dividend or earnings models, similar to DCF analysis above. These approaches infer MRP from current market prices, near-term forecasts of market performance, and long-term forecasts of the overall economy (Damodaran 2026). In an annually updated publication, Prof. Damodaran summarizes ongoing literature on calculating MRP and compares the analytical performance of multiple methodologies. His research consistently concludes that inferring MRP from discounted cash flow results in higher predictive accuracy for future MRP.

Numerous other approaches exist to calculate MRP, although none are preferred for the application of determining utility ROE. Duarte and Rosa (2015) summarize the general approaches for determining MRP: historical returns, implied models using discounted cash flows, regression approaches, and surveys. In the historical return approach, the MRP is calculated using the average of historical returns. This is a fundamentally backwards-looking metric and should not be used for rate making, which should respond to recent market conditions. Regression approaches attempt to predict MRP by using either the correlation of MRP with market fundamentals or the correlation with stock-specific correlations between risk and equity returns. In out-of-sample assessments, no regression approaches are shown to reliably predict MRP (Goyal et al. 2024; Welch and Goyal 2008). Survey methods can be a useful tool to gauge opinions on current market conditions, but should not be used to calculate MRP for utility regulation because the regulator cannot access the reasoning behind any MRP estimate as is desirable for transparent rate-setting.

MRP calculation should avoid relying on analysts' stock-level projections because these are known to be optimistically biased. Numerous academic studies have examined potential sources of bias and their impacts on analyst forecasts. Overall, this body of research shows that analysts are biased due to conflicts of interest, career concerns, and relationships with rated companies (Kothari et al. 2016). Empirical analysis finds that analysts' forecasts decline in quality the further into the future the forecast is, with notable biases as little as one year in advance (de Silva and Thesmar 2024). Many financial information services rely on these potentially biased analyst estimates in their MRP calculations, including Bank of America and Bloomberg.

To demonstrate the risk of relying on analyst-level forecasts, we compare the predictive performance of Bloomberg and Damodaran's MRP estimates. We compare annual estimates from 2000 onwards from both sources, as this is the longest possible comparison window. We compare the one-year-ahead and three-year-ahead predictions relative to the realized return of the S&P 500, net of any stock returns, less the 10-year treasury bond sale. These results are shown in Table 7 below. Damodaran's estimates result in considerably lower bias and higher correlation with the realized returns. These results also reflect the tendency of analyst forecast quality to decrease with longer time frames. The bias between Bloomberg MRP and realized returns increased when going from one year to three years, while the Damodaran bias decreased for the longer forecast horizon.

	One-Year Forecast		Three-Year Forecast	
	Bias	Correlation	Bias	Correlation
Damodaran	-0.34%	51%	0.18%	54%
Bloomberg	1.45%	35%	1.99%	37%

TABLE 7. BIAS AND CORRELATION OF PREDICTED MARKET RISK PREMIUM VERSUS REALIZED RETURNS

Beta Adjustment

Beta adjustment is used to address concerns with using betas derived from historical analysis of stock returns to project future returns. This can increase performance at predicting future stock returns and reduce volatility in raw beta values. A common adjustment technique is to take the weighted average of the current raw beta value and one, assuming that in the long run the beta value will tend towards one. This adjustment is employed by both Bloomberg and by Value Line. Bloomberg's beta adjustment is $\frac{2}{3}\beta + \frac{1}{3}$ while Value Line does not disclose their formula, only that it adjusts beta values towards one. We demonstrate that this adjustment is not appropriate in the utility industry because utility betas do not tend towards one, and the standard adjustment actually increases predictive error.

Some research supports the idea of adjusting betas towards one, although this conclusion does not hold for the utility industry in particular. Often termed the Fama-French critique, empirical research has shown that returns are higher than CAPM predicts among low-beta stocks and lower among high-beta stocks (Fama and French 2004). More recent work confirms that the betas used by investors are likely adjusted towards one relative to empirically derived betas, due to variation in investor expectations (Andrei et al. 2023). The intuition is that in the long run, stock performance on average exhibits mean reversion: returns tend towards the market-wide average. However, this intuition does not apply to the utility industry given the stable nature and consistently low returns. Research has demonstrated that this mean reversion does not apply to utility betas (Michelfelder and Theodossiou 2013).

Despite evidence that the Fama-French critique does not apply to utility betas, CAPM in utility regulation employs two techniques to address this observation: first, betas are adjusted towards one as recommended by the observation that investor betas are closer to one than empiricist betas; and second, an alternate form of CAPM is used that is algebraically equivalent to adjusting betas towards one. The format used in New York State is given below:

$$ROE_{Zero-Risk\ CAPM} = R_f + (0.75\beta + 0.25)(R_m - R_f)$$

We provide additional evidence that this adjustment is not appropriate, and propose an adjustment based on historical beta performance that results in improvements to the process. First, we gather historical beta values from Value Line and Bloomberg Terminal, and by calculating values from Yahoo! Finance's publicly available stock data. We find negligible differences between betas from Bloomberg Terminal and those calculated using Yahoo! Finance. For Bloomberg and Yahoo!, we calculate weekly and monthly betas relative to both the NYSE and the S&P 500. Value Line only provides weekly betas calculated relative to the New York Stock Exchange (NYSE).

Figure 8 below compares the beta calculations from Bloomberg Professional (both raw and adjusted) and the adjusted beta values from Value Line. All betas are calculated using weekly returns relative to the NYSE index, which is the only specification for which Value Line provides beta values. Solid lines show the average values from all utility companies in the proxy group, plotted over time. The dotted black line shows the running historical average.

These data reject the assumption behind the Bloomberg and Value Line adjustments, namely that betas tend towards one. Average raw beta values for the proxy group are always below one. Their long-term average value is approximately 0.56 over the entire time series. Because the utility group average value is always below one, the Value Line and Bloomberg beta adjustments always increase beta.

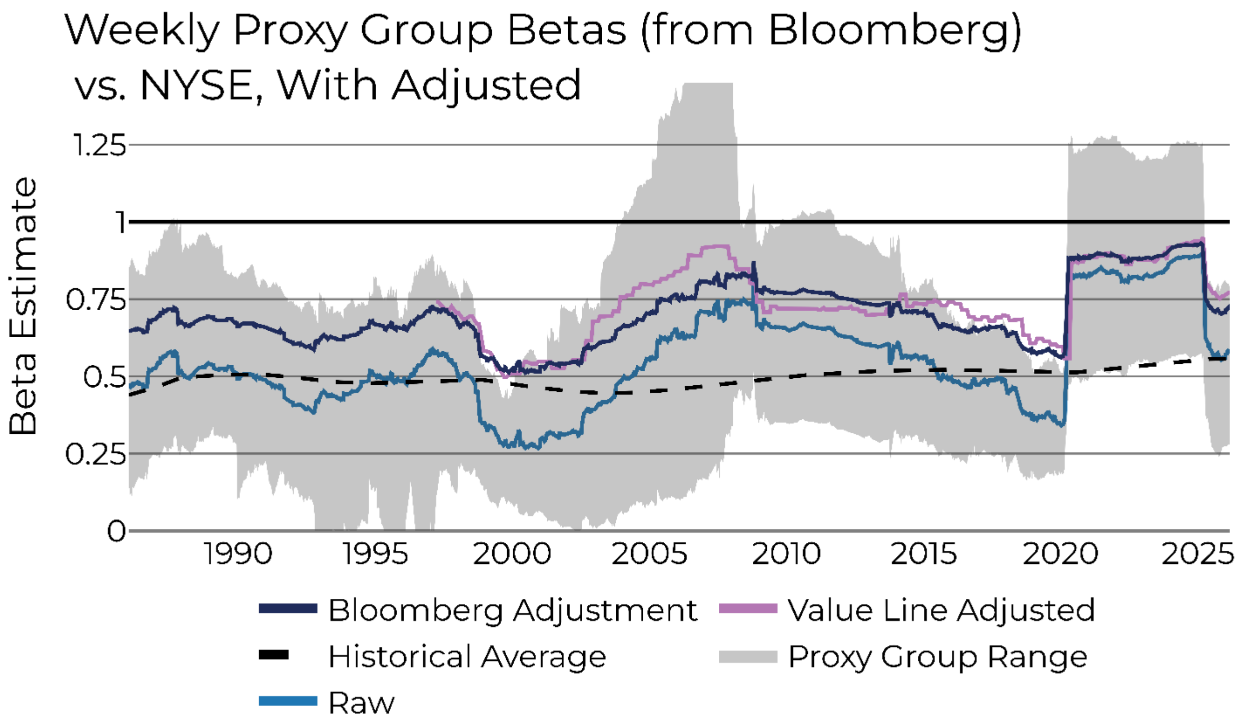

FIGURE 8: TIME SERIES OF WEEKLY PROXY GROUP BETAS

This observation implies a straightforward beta adjustment: the weighted average of the recent raw beta value and the long-term historical average of betas among the proxy group. This yields an adjusted beta value that tends towards the historical average rather than towards one. We compare the performance of this historically adjusted beta with the Bloomberg and Value Line adjustments, as well as raw betas.

To quantify the performance of different beta adjustments, we use the approach developed by Agrrawal et al. (2022). The authors assess predictive accuracy of different beta return periods by comparing the annualized tracking error across different specifications. The formula for annualized tracking return is below.

$$TE = \sqrt{\lambda \cdot \text{var}(R_E - \beta R_M)}$$

Where TE is the annualized tracking error; λ is the number of periods per year (i.e. 52 if using weekly return frequency or 12 if using monthly); R_E is the equity return over the time period; β is the (potentially adjusted) beta value; and R_M is the market return over the time period.

We calculate this value for each starting date up to January 1, 2023; for each equity in the proxy group; for both NYSE and S&P 500 market indices; for weekly and monthly return frequencies; for one-year-ahead and three-year-ahead forecasts; using raw beta values from Bloomberg Financial or calculated using Yahoo! Finance data; and using raw beta values, the Bloomberg beta adjustment, the historical average beta adjustment, and the Value Line beta adjustment. Because Value Line beta calculations are updated infrequently, when using the NYSE index and weekly returns we restrict the analysis to include only starting dates for stocks where the Value Line investment report included an update for that industry.

Table 8 and Table 9 below summarize this analysis, using Bloomberg data. Relative to the S&P 500 Index (the same index used to calculate the market risk premium), monthly betas provide considerably more accurate predictions on both the 1-year and 3-year tracking error metrics. For both time series in question, the Bloomberg Adjustment decreases performance relative to using raw betas, while the adjustment using the historical average improves performance. The comparison with the NYSE index (Table 9) includes a tracking error calculation using Value Line Adjusted Betas (which are only available relative to the NYSE index). While Value Line adjusted betas increase predictive performance relative to using raw weekly beta values, they result in considerably higher annualized tracking errors relative to the raw monthly or historically adjusted monthly betas. These values are strikingly similar when comparing using Yahoo! Finance data – annualized tracking errors are at most .03% different.

Number of Years' Forecast	Return Frequency	Raw (No Adjustment)	Historical Average Adjustment	Bloomberg Adjustment
1	Monthly	17.2	17.1 (-0.7%)	17.3 (+0.4%)
1	Weekly	19 (+10.3%)	18.9 (+9.7%)	19 (+10.6%)
3	Monthly	18.3	18.1 (-0.9%)	18.3 (+0.2%)
3	Weekly	19.7 (+7.9%)	19.6 (+7.2%)	19.7 (+7.8%)

TABLE 8. AVERAGE ANNUALIZED TRACKING ERROR USING S&P 500 INDEX AND VARIOUS BETA ADJUSTMENTS, USING BLOOMBERG DATA

Number of Years' Forecast	Return Frequency	Raw (No Adjustment)	Historical Average Adjustment	Bloomberg Adjustment	Value Line Adjustment
1	Monthly	17.6	17.5 (-0.8%)	17.6 (+0.1%)	
1	Weekly	18.8 (+6.6%)	18.7 (+5.8%)	18.7 (+6.4%)	18.8 (+6.6%)
3	Monthly	18.5	18.3 (-1.2%)	18.5 (-0.3%)	
3	Weekly	19.4 (+4.7%)	19.3 (+3.9%)	19.3 (+4%)	19.3 (+4.3%)

TABLE 9: AVERAGE ANNUALIZED TRACKING ERROR USING NYSE INDEX AND VARIOUS BETA ADJUSTMENTS, USING BLOOMBERG DATA

These results show that there is no empirical basis for using either the Bloomberg or Value Line beta adjustment. If at all, betas should be adjusted towards their historical average value. Additionally, monthly betas should be used because they result in significantly lower annualized tracking error than weekly betas.

Impact on ROE

We calculate the CAPM ROE using Damodaran's MRP and the historical average beta adjustment. Results are summarized in Table 10 below. Changing only the MRP to Damodaran's estimate reduces the CAPM ROE by 2.77%. Changing the beta to the raw value reduces CAPM ROE by 1.74%, and to the historical adjusted beta reduces ROE by 2.05%. Applying both changes results in an ROE of 6.33%, a reduction of 3.88%. We also recalculate the values using the stock data from February 2026, which results in an ROE of 6.49%.

	Risk-Free Rate (Treasury Bond Yield)	Market Return (Rm)	Beta	ROE	Diff
1. Company Methodology	4.18%	12.11%	0.76	10.21%	
2. Using Damodaran MRP	4.18%	8.46%	0.76	7.43%	-2.77%
3. Using Raw Monthly Betas vs. S&P 500	4.18%	12.11%	0.54	8.46%	-1.74%
4. Using Historical Avg. Beta Adjustment	4.18%	12.11%	0.50	8.16%	-2.05%
5. Using Damodaran MRP, Historical Avg. Beta Adjustment	4.18%	8.46%	0.50	6.33%	-3.88%
6. February 2026 Financial Data, Damodaran MRP, Historical Avg. Beta Adjustment	4.26%	8.51%	0.53	6.49%	-3.72%

TABLE 10: CAPM ROE RESULTS

GLOSSARY

Term	Definition
AHRF	Affordable Housing Reinvestment Fund
CAPM	Capital Asset Pricing Model
CBO	U.S. Congressional Budget Office
CLCPA	Climate Leadership and Community Protection Act
COMET	City-based Optimization Model for Energy Technologies
ConEd	Consolidated Edison
CPI	Consumer Price Index
CRSP	Center for Research in Security Prices
DCF	Discounted Cash Flow
EIA	U.S. Energy Information Agency
FY	Fiscal Year
GDP	Gross Domestic Product
LL97	Local Law 97 of 2019
MAPE	Mean Absolute Percentage Error
MRP	Market Risk Premium
NYSE	New York Stock Exchange
OMB	New York City Mayor's Office of Management and Budget
ROE	Return on Equity

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