Embedding Risks of Climate Change into the Sustainability Plan for New York City:

The Role of the NPCC in PlaNYC

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Policymakers, Practitioners, and Scientists Working Together

As the New York City government under the leadership of Mayor Michael Bloomberg began focusing on how to sustainably incorporate a large population increase in the coming decades, the City's planners realized that climate change would affect where and how significantly more people would live. To provide a robust evidence base for inclusion of climate change into PlaNYC, a groundbreaking policymaker-scientist partnership, the New York City Panel on Climate Change (NPCC), was forged in New York City. Co-generated science-based assessments of climate change impacts in New York – published in 2010; 2015; 2019; 2024 – provided key foundational knowledge for the PlaNYC launched in 2007 and its subsequent implementation, not only in New York but in cities around the world.

This paper addresses the questions: How did the NPCC come to be formed? What "enabling conditions" were present? Were there "prequels" and What were its major contributions to PlaNYC? The paper presents how the NPCC scenarios and projections were initially developed and used by the City, describes disconnects between what the scientific projections were able to encompass and what the City and infrastructure operators, in particular, wanted and needed, and how the demand for and supply of projections evolved.

The paper also discusses the impacts that the NPCC outputs led to, such as Local Law 42 passed by the New York City Council in 2012 to establish the NPCC permanently and the creation of the NYC Design Guidelines in 2013. To answer these questions and provide evidence of the impacts, the paper presents an analysis of the results of the Climate Impacts Origins NPCC Project (see Appendix 1), an archival study of documents relevant to the founding, activities, and outcomes of the NPCC, as well as relevant literature (e.g., Solecki et al., 2021). See Appendix 2 for a full timeline of NPCC activities.

As a part of the development of this paper, a series of 360 Evaluation interviews were conducted to better understand the strengths of the NPCC, the issues that arose during its early iterations, and its lasting impacts. The interviews were held with NPCC members, NYC policymakers, and NYC practitioners, with 2-4 interviews held with representatives from each group (see Appendix 3 for interview questions).

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Section 1 NPCC Chronology (2007-2015)

In this section, we highlight the chronological components of the NPCC process: Early Foundational Reports, The Metropolitan East Coast Report, the Deep Dive by the NYC Department of Environmental Protection, the Severe Thunderstorm on August 8, 2007, NPCC Formation, Initiation of Climate Change Projections, Local Law 42, Hurricane Sandy, and the NYC Design Guidelines.

Early Foundational Reports

This paper examines the roots of the NPCC starting with early efforts that included *The Baked Apple Reports* of the Regional Plan Association (Hill, 1996) and the Environmental Defense Fund's *Hot Nights in the City* (EDF, 1999). The *Baked Apple Reports* provided a foundational analysis of mitigation in New York City. These reports outline the methods for predicting future electricity requirements using utility forecasting and computer programming.

Expanding the mitigation focus of *The Baked Apple Report*, *Hot Nights in the City* highlighted climate risks and provided some of the earliest projections of climate change for the city (EDF, 1999). The EDF report projected 5 – 10°F of warming by 2100 and increased frequency of heat waves with decreased nighttime cooling. The report also stressed the severity of public health risks, such as heat stress, and the amplification of the urban heat island (EDF, 1999).

The NPCC precursors developed by non-profit organizations, e.g., the Regional Plan Association and the Environmental Defense Fund, played a key role as an enabling condition for the City to begin to address climate change since they represent civil society broadly. Tracing its origins back to 1922, the Regional Plan Association (RPA) is a highly respected urban planning NGO. From its headquarters in New York, the Environmental Defense Fund was responsible for bringing climate change forward as a significant issue very early in the United States.

Attention from the Feds – The Metropolitan East Coast Report

The original work that encompassed a comprehensive integrated science-based assessment of climate change impacts in the New York region is *Climate Change and A Global City: The Metropolitan East Coast Regional Assessment of Potential Climate Variability and Change* (MEC Report) (Rosenzweig and Solecki, 2001). The MEC Report was part of the larger first U.S. National Assessment of Climate Variability and Change that was undertaken under the Clinton administration (1993-2001) (NAST, 2000). Building on the climate change focus provided by the RPA and EDF reports, this foundational assessment laid the groundwork for the stakeholder-scientist partnership to address climate change driven-risks in the New York Metropolitan Region. MEC Report authors were drawn in part from the contributors of the RPA reports. The

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downscaled climate projection methodology used in the MEC Report was based on the projection methods developed for the EDF Report.

Right from the beginning, teams of experts and stakeholders addressed the full set of elements – people, place, and pulse – that comprise the socio-ecological system of the urban region: infrastructure, sea-level rise and coasts, wetlands, water supply, public health, energy demand, and decision-making (Figure 1).

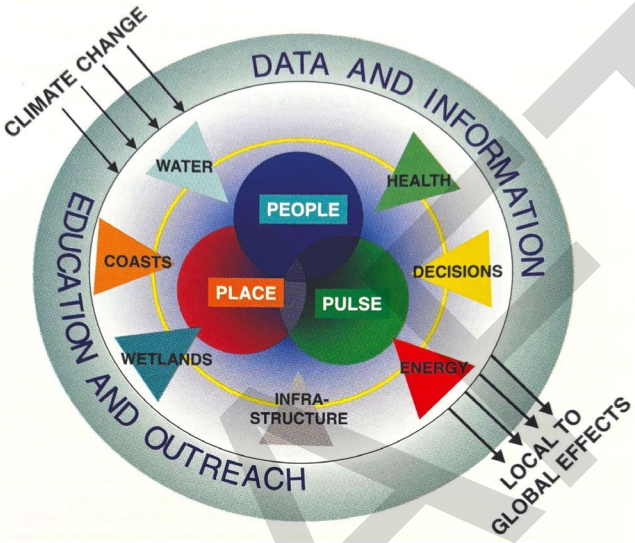


Figure 1. The MEC study's framing diagram revolves around the three overlapping interests of people, place, and pulse, which are the core focus areas of this assessment.

The MEC Report identified as future risks rising temperatures, more damaging coastal storm floods, risks to low-elevation infrastructure, higher electricity demand, loss of wetlands, more droughts and inland floods, and increase in summer-season heat stress morbidity and mortality, especially amongst elderly low-income individuals (Rosenzweig and Solecki, 2001). Time frames of the study were mid-century and beyond, with a clear understanding that climate change was a future challenge that must be addressed for the city and the region. It emphasized that involvement of decision-making institutions is critical to adapt to and reduce the negative impacts of climate change.

In 2001, The MEC Report concluded:

> The complex nature of potential climate change impacts to urban regions poses tremendous challenges to urban managers to respond cooperatively, flexibly, and with far longer decision-making timeframes than currently practiced. Given the already fragmented nature of urban environments and jurisdictions, the political and social responses to the global climate issue in cities should begin at once. Transforming urban

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management to better prepare for climate change will safeguard against negative feedbacks in the Metro East Coast Region and around the world.

The report was released just prior to the 9/11 attacks and the ensuing devastation to lower Manhattan and provided a resource during the recovery period. The attacks highlighted the fragility of the city's infrastructure and well-being and brought into great relief the need for protection and resilience. While the opportunity to incorporate climate change projections into the rebuilding efforts was largely not taken during this perilous time, the understanding of how that condition could take place in the future became evident.

Agency-wide Deep Dive by the NYC Department of Environmental Protection

The New York City Department of Environmental Protection (DEP) played a key role in the embedding of climate change within an operational city agency. Following the MEC Report, the DEP continued to work on climate change vulnerability, impacts, and responses on the City's water resources, showing the way for how a city agency can embed climate change into its full set of activities.

Water is often considered the "primary climate change impact sector." Treating water resources as a primary impact sector means evaluating how human actions and climate shifts directly alter freshwater availability, quality, and aquatic ecosystems (World Bank Group, 2026). DEP Commissioners who championed this initiative included Christopher Ward (2002-2005) and Emily Lloyd (2005-2009). The early champion was Chris Ward, then commissioner of the NYC DEP, who responded directly to the MEC Report results and realized that climate change would have direct and potentially highly negative impacts on the water resources of New York City. He engaged with the MEC Report authors directly and followed up by authorizing DEP to conduct the early assessment that included members of every DEP bureau, with funding provided by the New York City Water Board. There were also early interactions between MEC and GISS Climate Impacts Group researchers with the DEP upstate water system modelers to conduct detailed projection studies together.

All DEP departments were engaged with scientists in the DEP assessment, exploring together how the upstate water supply, transport, and wastewater treatment plants would be affected by climate change and how each of these divisions might effectively respond. The Assessment culminated in two major reports, the *DEP Climate Change Assessment and Action Plan* (2008) and the *Watershed Protection Program Summary and Assessment (2011)* (NYC DEP 2008, NYC DEP 2011).

The following Commissioners, Caswell F. Holloway IV, who was appointed in November 2009 and in office from January 2010 to August 2011, and Carter H. Strickland, Jr., who was appointed in August 2011 and in office from 2011 to 2014, continued the initiative spearheaded

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by Chris Ward and Emily Lloyd by tackling specific climate change challenges within the agency, such as those captured by the NYC Wastewater Resiliency Plan (NYC DEP, 2013).

Catalytic Extreme Event I – Severe Thunderstorm on August 8, 2007

Throughout the early years of climate change awareness in NYC, initial recognition of climate risks within major city agencies was raised by the occurrence of extreme weather events and their impacts on New York City infrastructure. For example, in the midst of the NYC DEP Assessment period, an intense rain event on August 8, 2007, which followed two similar events just in the year before, flooded significant portions of the NYC subways. This proved to be the first catalytic extreme event to focus transportation agency attention on the need for resilience planning (Table 1). Two and a half inches of rain fell in one day and caused flash flooding throughout the city. In response, the Metropolitan Transportation Authority (MTA) released a *Stormwater Assessment* in August 2007. The publication evaluated flood risks to regional transportation, which included low-lying and underground infrastructure and identified the growing need to integrate climate hazards into urban infrastructure planning (MTA, 2007).

Table 1. MTA Disruptions Due to August 8, 2007 Intense Rain Event (MTA, 2007).

	Number of Line Segments with Reduced or No Service			
	Sept. 8, 2004	April 15, 2007	July 18, 2007	Aug. 8, 2007
All Disruptions	7	12	9	19
Disruptions of 3 to 8 hours	2	7	2	6
Disruptions of over 8 hours	3	1	0	4

Increased precipitation intensity, sea level rise, and storm surge were also identified as key climate stressors that exacerbate flooding across the NYC transit system, particularly when compounded during extreme events. The assessment also emphasized that climate change would not only affect physical infrastructure but also system operations and reliability. The MTA underscored the need to incorporate climate considerations into long-term financial planning and infrastructure management (MTA, 2007).

Role of Leadership – Formation of the New York City Panel on Climate Change

As the PlaNYC Sustainability Plan was in development, discussions took place between the Bloomberg administration and the researchers who had worked on the Metro East Coast Assessment and the NYC DEP prequel activity. Many of these researchers had worked on the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR4) as well (IPCC, 2007). As a result of these discussions, the Bloomberg administration embraced the need

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for adaptation as well as mitigation in PlaNYC. After the earlier focus on mitigation for the city, Mayor Michael Bloomberg commissioned the New York City Panel on Climate Change (NPCC) in August 2008, which came shortly after launching the PlaNYC Sustainability Plan (City of New York, 2007). A wide range of expertise was represented by the members of NPCC1, who were vetted by the City and served at the discretion of the Mayor. A list of NPCC members and authors can be found in Appendix 4.

The early focus of the NPCC was on adaptation, defined in IPCC AR4 as: “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007). After NPCC1 there was a clear pivot to resilience in the subsequent NPCC2 (2015), NPCC3 (2019), and NPCC4 (2024) Reports. This pivot was based on shifts within the policy and academic landscape. With respect to public policy a shift to resilience opened up the opportunity to connect current efforts such as disaster risk reduction and emergency response to longer–term objectives of climate change adaptation.

At the same time, resilience as a concept was increasingly being applied in a variety of quarters including the IPCC and high–level NGOs and foundations, such as the Rockefeller Foundation 100 Resilient Cities program. In response to this evolution, the IPCC in the AR5 report cycle published in the early and mid 2010s defined resilience as "the capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation” (IPCC, 2014).

NPCC1 focused on developing a risk management strategy for the city, identifying adaptation solutions for critical infrastructure systems and providing insights into laws and regulations as well as the role of the insurance industry. At the recommendation of both the City and the NPCC1 leadership, NPCC1 members included representatives from key stakeholder groups including the insurance, legal, and business consultancy sectors.

Initiation of Climate Change Projections

The NPCC initiated work in August of 2008 and published its first assessment on climate change in New York City in 2010 (NPCC1) (NPCC1, 2010). The NPCC created new methods for predicting climate change for the city and its environs. Drawing on approaches used by the IPCC AR4, the NPCC was designed as a science and policy interface that translated global climate data into localized projections, including temperature and precipitation (see Figure 2). The main contributions of the IPCC were in the use of the Special Report on Emissions Scenarios (SRES) to take into account uncertainties in future greenhouse gas emissions trajectories and in the use of multiple climate models from Coupled Model Intercomparison Project Phase 3 (CMIP3) to

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span the range of projections for a given scenario (CMIP Phase 3, 2007). The contribution of the NPCC was to downscale the global climate projections to the specific gridboxes that encompass the New York Metropolitan Region.

Temperature and Precipitation Projections

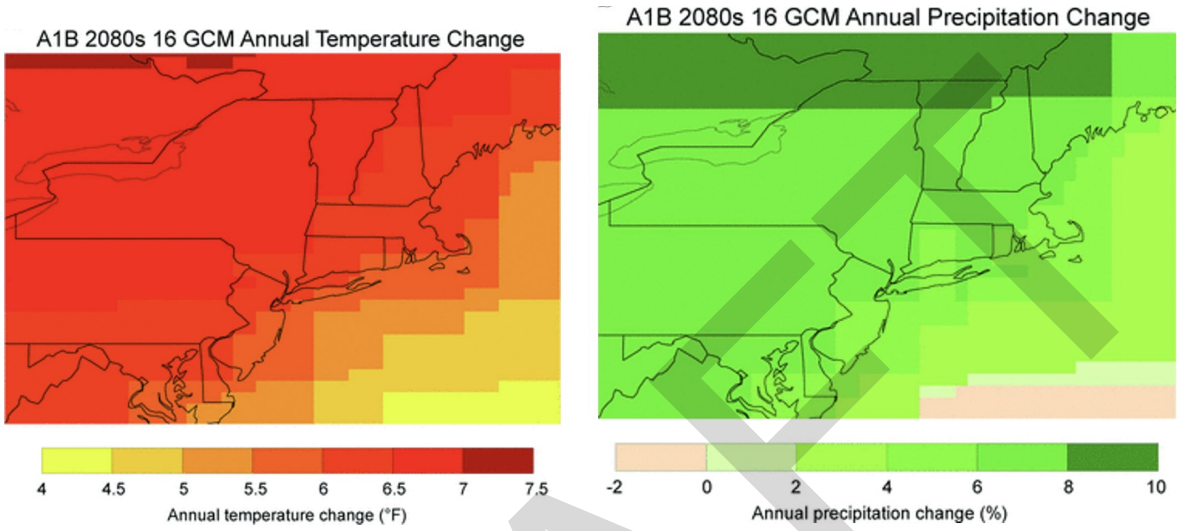
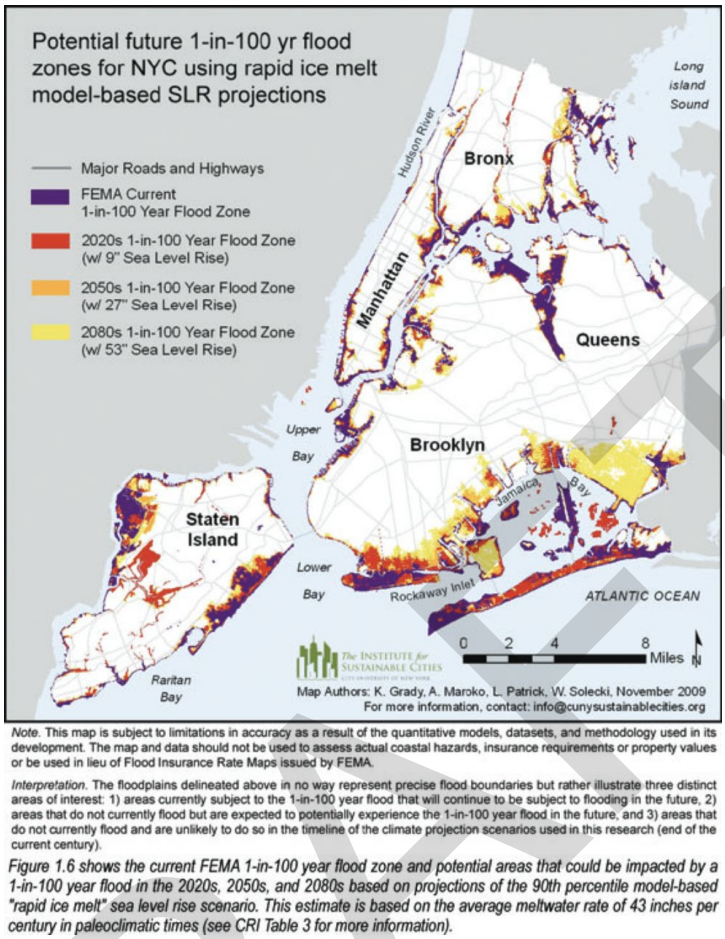


Figure 2 (left). Annual temperature changes in the 2080s, relative to the 1971–2000 base period. Source: NPCC1 and Columbia University Center for Climate Systems Research. **Figure 2 (right).** Annual precipitation changes in the 2080s, relative to the 1971–2000 base period. Source: NPCC1 and Columbia University Center for Climate Systems Research.

Sea Level Rise Projections

Another major contribution of the NPCC was to develop more detailed sea level projections than were available from the IPCC (see Figure 3). The NPCC developed maps that demonstrated the possible landward inundation of a 1-in-100-year flood in the 2020s, 2050s, and 2080s. The map incorporated sea level rise projections at the 90th percentile of global climate models for each period, both with and without rapid ice melt. The NPCC1 Report explained that maps were not to be taken as delineating precise flood boundaries, but instead as demonstrating certain distinct areas. These are: areas currently in the FEMA designated 1-in-100-year flood zone, areas not in the existing flood zone, but could be in the future as a result of sea level rise, and areas not in the existing flood zone and not likely to be so through the end of the century.

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Note. This map is subject to limitations in accuracy as a result of the quantitative models, datasets, and methodology used in its development. The map and data should not be used to assess actual coastal hazards, insurance requirements or property values or be used in lieu of Flood Insurance Rate Maps issued by FEMA.

Interpretation. The floodplains delineated above in no way represent precise flood boundaries but rather illustrate three distinct areas of interest: 1) areas currently subject to the 1-in-100 year flood that will continue to be subject to flooding in the future, 2) areas that do not currently flood but are expected to potentially experience the 1-in-100 year flood in the future, and 3) areas that do not currently flood and are unlikely to do so in the timeline of the climate projection scenarios used in this research (end of the current century).

Figure 1.6 shows the current FEMA 1-in-100 year flood zone and potential areas that could be impacted by a 1-in-100 year flood in the 2020s, 2050s, and 2080s based on projections of the 90th percentile model-based "rapid ice melt" sea level rise scenario. This estimate is based on the average meltwater rate of 43 inches per century in paleoclimatic times (see CRI Table 3 for more information).

Figure 3. Areas potentially at-risk to the 1-in-100 year floods in NYC due to rapid ice melt sea level rise projections derived from global climate models.

NPCC Outcome I – City Council and Local Law 42

Since 2008, the NPCC has served as a sustained assessment for the city and its metropolitan region across the three states of New York, New Jersey, and Connecticut. With energetic leadership by James Gennaro, Chair of the Environment Committee of the New York City Council, Local Law 42 of 2012 institutionalized the NPCC[1]. Through this legislation, the City Council of New York City codified the NPCC in August 2012. This was then signed by Mayor Bloomberg in September, requiring the establishment of the NPCC as a body to provide regular climate science updates and localized projections.

The law acknowledged that climate change would significantly impact the City's critical infrastructure and vulnerable populations, and that to appropriately respond to these effects,

[1]To align with the timing of formally mandated recommendations with larger assessment processes, Local Law 42 was amended by the enactment of Local Law 149. This update went into effect as of October 25, 2025 (The New York City Council, 2026).

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updated climate models would be required (The New York City Council, 2026). Therefore, it required foundational and ongoing climate risk assessments and adaptation planning across city agencies and across mayoral administrations. The passage of this law is a significant outcome, ensuring the NPCC's work will continue in NYC. At the time of its introduction and passage, there was little or no pushback to the passage of Local Law 42.

Catalytic Extreme Event II – Hurricane Sandy October, 2012

On October 29, 2012, Hurricane Sandy made landfall near Atlantic City, New Jersey, impacting New York City's southern coast during high tide. At its greatest extent, the storm's wind field measured about 1,000 miles (about 1,609 km) in diameter, making it the largest Atlantic hurricane on record (USGS, 2015). Forty-three New Yorkers lost their lives due to Hurricane Sandy. The storm surge in The Battery reached 9.4 ft (2.87 m) high, wind gusts reached up to 73 mph (117.5 kph), and parts of NY experienced 5.4 to 6.5 ft (1.5 to 2.0 m) of inundation.

Disaster response occurred primarily through the Mayor's Office, which had already mapped NYC hazards through PlaNYC. The storm's acute impacts shifted NYC's immediate focus towards economic recovery and response and paused coordinated long-term climate change adaptation planning. The NYC Office of Emergency Management's role was to organize the flood zone evacuations, run the hurricane evacuation centers, educate New Yorkers on disaster preparedness, and work with organizations such as the American Red Cross, NYC Fire Department, and NY Community Emergency Response Teams. Public-private partnerships, disaster grants, and volunteer organizations played a crucial role in short, mid, and long-term recovery and resilience.

In both short-term rebuilding and long-term reconstruction post-Hurricane Sandy, NYC has embedded climate change projections into infrastructure and policies to be better prepared for future coastal storms. Hurricane Sandy was a tipping point for resilience planning in New York City, and because of this extreme event, vital lessons were learned to prepare for future climate extremes while incorporating relevant climate science into policy-making. It also became clear that the work of the NPCC and its application into public policy aided in the decision-making process in advance of the storm that reduced losses and damages.

Hurricane Sandy became a key learning opportunity for NPCC scientists and City planners. The recognition that Hurricane Sandy and its impacts exceeded the acceptable level of risk reinforced the need for both public policy and climate science to be responsive to emergent conditions (Rosenzweig and Solecki, 2014). Post-event workshops and dialogue sessions were urgently convened to better identify knowledge and information gaps and define pathways to fill them.

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Major Outcome – NYC Design Guidelines

As a result of Hurricane Sandy and the work of the NPCC, NYC prepared design guidelines for use in all NYC projects going forward. The goal was to increase safety standards and enhance preparedness for future extreme events. *Designing For Flood Risk*, published in June 2013, is the first written design guide for New York City that addresses the challenges of building reconstruction, i.e. freeboard standards, after Sandy with a focus on preparing buildings to withstand coastal flooding in both the current and future climate (see Figure 4). The City engaged in a major rollout of the Design Guidelines to all the relevant agencies and the public.

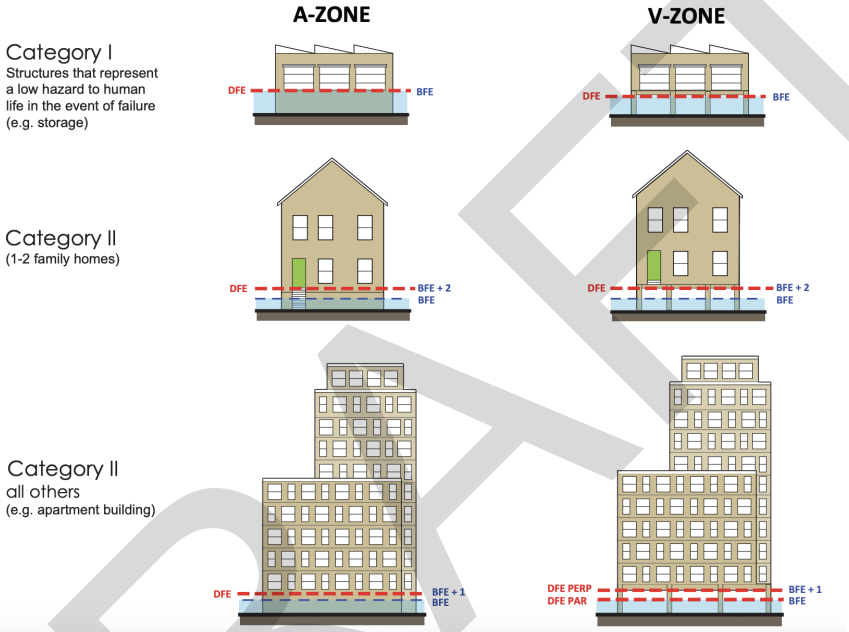


Figure 4. Minimum elevation requirements for buildings in flood zones by structure category, reflecting updates to the NYC Building Code 2008 following Hurricane Sandy in 2012. Revisions based on coastal flooding projections from the New York City Panel on Climate Change (*Designing for Flood Risk*, 2013).

The City Updated Guidelines were released in 2015 that used updated FEMA flood zones and included modifications to the National Flood Insurance Program. This coding and zoning mandate states that many of the buildings that need to be rebuilt because of Sandy must include water sprinklers to reduce the risk of fire (de Blasio and Chandler, 2015). Additional planning tools highlighted in "A Stronger, More Resilient New York" (SIRR) include *Zoning for Coastal Flood Resiliency: Planning Resilient Neighborhoods*, *Financial District and Seaport Climate Resilience Master Plan, Urban Waterfront Adaptive Strategies (UWAS)*, and *One New York: The Plan for a Strong and Just City*, and the NYC Flood Hazard Mapper[2]. This set of

[2] The most recent (updated April 2026) flood mapping tool: https://experience.arcgis.com/experience/0d0603210dde48ad92b77d0efd14eff6/

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planning tools provided the City with the information and platforms needed to rebuild after Hurricane Sandy.

Section 2 Key Components of NPCC Process

In this section, we highlight three key components of the NPCC process: Co-Generation, Evolution of Scenarios and Projections, and Flexible Adaptation Pathways.

Co-Generation

A key outcome of the NPCC1 work was the co-generation, with the City, of model output ranges that would be useful for city practitioners and policymakers. Co-generation refers to the process whereby scientists and decision-makers work together to develop local, actionable science risk information (Bader et al., 2026). The specification of what was to be considered low (10%), mid range (25-75%), and high (90%) model output values became the accepted metrics for conveying information regarding future climate projections. Other key products that were co-generated included several Appendices to the NPCC1 Report: *Climate Risk Information: Climate Change Scenarios and Implications for NYC Infrastructure, Global Climate Model (GCM) Methods and Projections, Sea Level Rise Methods and Projections, and Sector-Specific Impacts* (NPCC1, 2010).

Shortly after Mayor Bloomberg established the NPCC as the body of scientists and experts advising the City on climate change in 2007, he established the NYC Climate Change Adaptation Task Force (CCATF) in 2008. The NPCC worked in coordination with the NYC Climate Change Adaptation Task Force (CCATF) to incorporate climate science and recommendations into both infrastructure planning and city operations[3]. An example is the key request from the City for NPCC to provide "climate risk tear sheets" so that all relevant city workers could have easy access to the climate change projections.

Besides the representatives from the relevant city agencies, the CCATF consisted of the infrastructure operators for the New York Metropolitan Region, with participation by the

Dashboard with resiliency efforts through the City Comptroller office: https://comptroller.nyc.gov/services/for-the-public/nyc-climate-dashboard/resiliency/
Map of ongoing resiliency projects: https://data.cityofnewyork.us/City-Government/NYC-Recovery-Resiliency-Projects-Map-Points/kubx-z7zd

[3]CCATF was directed by the Office of Long-Term Planning and Sustainability and includes representatives from the Department of Buildings, Department of Design and Construction, Department of City Planning, Department of Environmental Protection, Department of Information Technology and Telecommunications, Department of Parks and Recreation, Department of Sanitation, Department of Transportation, Economic Development Corporation, Office of Emergency Management, Office of Management and Budget, Department for the Aging, and Department of Health and Mental Hygiene, along with public members from the health care, telecommunications, energy, and transportation sectors appointed by the mayor.

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encompassed public and private entities responsible for transportation, energy, water, telecommunications, and public health systems. Agencies included the Metropolitan Transportation Authority, the Port Authority of New York and New Jersey, the New York City Department of Environmental Protection, and utilities like Con Edison and National Grid. Telecommunications providers such as Verizon and AT&T, along with agencies including the New York City Office of Emergency Management and the New York City Department of Health and Mental Hygiene, were also involved.

Both public and private agencies and organizations were engaged actively in the co-generation process so that the NPCC scientists and the infrastructure operators together produced actionable, localized climate projections to support planning and risk management. Over time both the demand for and the supply of projections evolved to become more detailed, decision-relevant, and responsive to sector-specific needs. The CCATF operators have drawn on NPCC projections to help inform assessments of vulnerability and support infrastructure planning, operations, and investment decisions.

All of these products and outcomes emerged from a robust and reflexive relationship between scientists and stakeholders that focused on co-generation. Thus, the NPCC did not focus solely on projecting climate risks, but incorporated action pathways leading to implementation. The relationship between the NPCC and the City was fueled by deep respect, collaborative learning, listening, and debate, with each side growing in sophistication and understanding.

Evolution of NPCC Scenarios and Projections

To assess the impacts of climate change and to evaluate potential adaptations, the NPCC analyzed *historical climate trends, current climate extremes, and future climate scenarios* (NPCC4, 2024). NPCC1 (2010) translated global climate models into localized projections for New York City, establishing the foundation for climate risk assessment. NPCC2 (2015), which was informed by Hurricane Sandy, refined projections with updated data and strengthened the focus on extreme events and coastal flooding. NPCC3 (2019) further advanced the use of the projections by placing emphasis on urban stakeholder engagement and the application of the climate risk information in infrastructure planning and decision-making.

The decision to use low estimate, middle range, and high estimate projections with 90% model-based probabilities as the cut off was an important co-generated benchmark decision. This decision was reached after a dialogue between NPCC scientists and city practitioners, balancing scientific integrity with risk tolerance. This co-generated selection of the 90th percentile arose from the CCATF stakeholders asking the scientists: “What is the worst that could happen?” The scientists responded with their judgment that the 90th percentile is a plausible upper bound for

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the risk. This is because the provision of the "maximum" model-based risk would represent only one GCM, rather than the full suite of 16.

While heat is the deadliest chronic hazard for people in NYC and intense inland precipitation is highly destructive to the city's homes and its infrastructure, a special emphasis throughout the NPCC was placed on sea level rise, since it is arguably the greatest risk to the 520 miles of coastline in New York City. As the NPCC progressed, greater risks of sea level and associated coastal flooding emerged. In NPCC1, high-end scenarios and the Rapid Ice Melt Scenario were considered. The Rapid Ice Melt Scenario was based on observed trends in melting of the West Antarctic and Greenland ice sheets (NPCC1, 2010). NPCC3 then included the Antarctic Rapid Ice Melt (ARIM) scenario, which accounts for potential accelerated ice sheet losses and higher-than-expected sea level rise, recognizing that traditional model-based projections may underestimate future risks. This high-end risk scenario reflects the need to consider low-probability, high-impact outcomes and incorporate deep uncertainty into long-term climate risk assessment and planning (Table 2). The ARIM scenario was shown for awareness purposes of growing risk, not for direct use by city practitioners, due to its uncertainty and the fact that the City had shared previous NPCC projections with city agencies through the Design Guidelines of 2017.

Table 2. New York City sea level rise projections, including the new Antarctic Rapid Ice Melt (ARIM) scenario, relative to 2000–2004 (in feet). The ARIM scenario was shown for awareness purposes of growing risk, not for direct use by city practitioners.

	NPCC2 2015 sea level rise projections [a] Projections of record for planning			NPCC3 ARIM scenario [b] Growing awareness of long-term risk
Baseline (2000–2004) 0"	Low estimate (10th percentile)	Middle range (25–75th percentile)	High estimate (90th percentile)	ARIM scenario[a]
2020s	0.17 ft	0.33–0.67 ft	0.83 ft	–
2050s	0.67 ft	0.92–1.75 ft	2.5 ft	–
2080s	1.08 ft	1.50–3.25 ft	4.83 ft	6.75 ft
2100	1.25 ft	1.83–4.17 ft	6.25 ft	9.5 ft

By NPCC4 (2024), projections had evolved into more integrated, spatially detailed assessments that account for social vulnerability and systemic risks (See Table 3). This is primarily the result of the inclusion of social scientists and environmental justice stakeholders into the NPCC process as it advanced. In NPCC2, a chapter on public health impacts and resilience was added

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(Kinney et al., 2015), and a chapter on community-based assessment of adaptation and equity was added in NPCC3 (Foster et al., 2019).

Table 3. Projections for extreme heat and extreme precipitation events in NYC for 2030–2100 (NPCC4, 2024).

2030s	Baseline	10th Percentile	25th Percentile	75th Percentile	90th Percentile
Days at or above 90°F	17	27	27	46	54
Days at or above 95°F	4	8	8	17	27
Days at or below 32°F	70	34	39	52	58
Days at or above 1 inch precipitation	14	14	14	16	17
Days at or above 2 inches precipitation	3	3	3	4	5
Days at or above 4 inches precipitation	0.2	0.2	0.3	0.4	0.4
Number of heat waves	2	3	3	6	7
Avg. length of heat waves (days)	4	5	5	5	6

Flexible Adaptation Pathways

A key question is how New York City has adapted through time utilizing the evolving NPCC information (Rosenzweig and Solecki, 2014). The Flexible Adaptation Pathways framework, with input from the City of London and the UK Department of Environmental Protection, was co-developed for NPCC1 by the NPCC members and the City points of contact (NPCC1, 2010, Lowe et al., 2008, Reeder and Ranger, 2011, Ranger et al., 2013). The concept, which was updated in subsequent reports and publications, illustrates how cities can monitor climate risks over time and adjust adaptation actions as new information and risks emerge (Figure 5). Flexible adaptation pathways are a dynamic, iterative planning approach in which adaptation actions are implemented in stages and adjusted over time in response to evolving climate projections, observed impacts, and decision thresholds.

The NPCC underscored that flexible adaptation pathways are designed to adjust over time. Adaptations are linked to acceptable risk thresholds and should be reassessed periodically, rather than relying on an approach that establishes inflexible standards for adaptation early in the process (NPCC, 2010; Rosenzweig and Solecki, 2014). In the long-term, permanent, inflexible approaches (e.g., sole reliance on large-scale storm surge barriers) are often costlier and less effective than flexible adaptation pathways in adapting to dynamic climate change conditions. Significantly, Local Law 42 of 2012 was set in place 2 months before Hurricane

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Sandy and helped to formalize the flexible adaptation pathway approach within the City's response strategy.

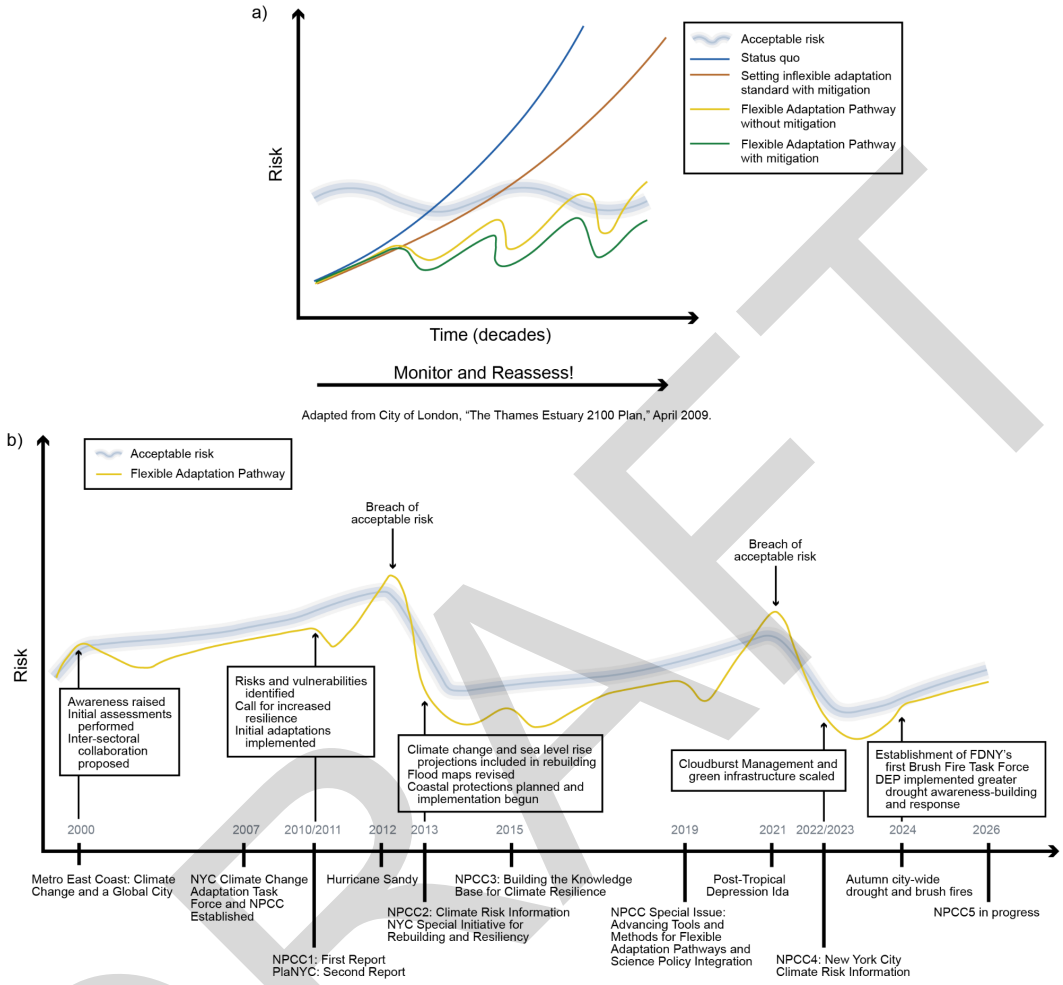


Figure 5. (a) Generalized Adaptation Pathways and relationship to socially acceptable level of risk (NPCC1, 2010). (b) Flexible Adaptation Pathway, key milestones, and relationship to socially acceptable level of risk in the New York metropolitan region, 2000–2026. (Rosenzweig and Solecki, 2001; NPCC, 2015; PlaNYC, 2013; NYC CDBG-DR, 2023; FDNY, 2024; NOAA, 2026; NYC DOT, 2026; NYC DEP, 2026).

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Section 3 Strengths, Challenges, and Recommendations: 360 Evaluation by Policymakers, Practitioners, and Scientists

NPCC scientists, New York City policymakers, and practitioners were interviewed to further evaluate the impact of the NPCC in PlaNYC and the City's climate policies. Nine interviews were conducted via Zoom and were then analyzed for key themes by researchers.[4] See Table 4 for the list of interviewees. Participants were asked about strengths and challenges of the NPCC, as well as recommendations for both future NPCC reports and the City. A list of interview questions can be found in Appendix 3.

Table 4. NPCC Interview Participants and Role within the NPCC

A) NPCC Scientists

Individual	Affiliation During NPCC1	Current Affiliation
Dr. Radley Horton	Columbia University Center for Climate Systems Research	Lamont-Doherty Earth Observatory, Columbia Climate School
Dr. Klaus Jacob	Lamont-Doherty Earth Observatory, Columbia University	Lamont-Doherty Earth Observatory, Columbia Climate School
Dr. Gary Yohe	Department of Economics, Wesleyan University	Department of Economics, Wesleyan University
Dr. Rae Zimmerman	The Robert F. Wagner Graduate School of Public Service, New York University	The Robert F. Wagner Graduate School of Public Service, New York University

B) New York City Policymakers

Individual	Affiliation During NPCC1	Current Affiliation
Adam Freed	New York City Mayor's Office of Long-Term Planning and Sustainability	Bloomberg Associates
Daniel Zarrilli	New York City Economic Development Corporation	Moffatt & Nichol

[4] Interviews were recorded on Zoom and Otter.ai was used to produce transcripts. These transcripts were then validated and analyzed by researchers.

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C) Practitioners

Individual	Affiliation During NPCC1	Current Affiliation
Alan Cohn	New York City Department of Environmental Protection	New York City Department of Environmental Protection
Dr. Thomas Matte	New York City Department of Health and Mental Hygiene	Human Habitat 4 Health
Edna Sussman, Esq.	SussmanADR LLC	SussmanADR LLC

Strengths of the NPCC Process

The interviewees brought forward some of the significant strengths of the NPCC process. These are summarized below with illustrative quotes.

"Having this consistent set of projections to work off of has been hugely important, a consensus voice on what projections we should be using." - Alan Cohn

NPCC provided one authoritative and unified baseline that policymakers and practitioners could turn to for reliable, standardized information.

"The magic of the NPCC was its breadth, covering multiple domains, encompassing the natural, built, and social systems, and as such, it was able to build networks and connections across those domains." - Rae Zimmerman

The breadth of NPCC expertise drew on different knowledge bases across natural, built, and social systems, thus reducing sectoral barriers.

"The only way to assure continued implementation is to have it built into a law or regulation." - Edna Sussman

The NPCC was institutionalized into city law through the New York City Council's Local Law 42 of 2012, updated as of 2025. This demonstrated foresight on the part of New York City, ensuring that the critical work of the NPCC would continue and would be revisited in a timely and consistent manner.

"That's a really important part of the story … the iteration of the panel itself. … it allows it to evolve and remain relevant as administrations change, knowledge bases change, and communities change." - Gary Yohe

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The work of NPCC was iterative as well as nimble. It evolved and remained relevant as mayoral administrations changed.

"If we came to them [the practitioners] as a city and said, 'Here are your risks. We did it for you', we would not have gotten any degree of the buy-in that we got." - Adam Freed

NPCC's collaborative nature and direct access to scientists fostered a higher level of buy-in among policymakers and practitioners than a static report alone would provide.

Challenges of the NPCC Process

The interviewees also brought forward some of the significant challenges that arose during the NPCC process. These are summarized below with illustrative quotes.

"NPCC was very cautious not to dictate a particular percentage." - Klaus Jacob

One major challenge was balancing scientific rigor and the needs of New York City decision-makers. Stakeholders such as engineers preferred to receive an exact number to represent a particular climate risk; however, future climate change is uncertain due to multiple factors, and the NPCC scientists insisted that future climate projections need to be expressed in ranges, not precise numbers.

"The biggest challenge for us was trying to convey that we never can give exact probabilities." - Radley Horton

This led to a further challenge, which was maintaining stakeholder interest in utilizing climate projections despite scientists' limited ability to provide precise estimates of the likelihood, characteristics, and timing of certain risks.

"With the projections themselves, we were cautious about changes that might make it look like there's either whiplash or that things are just constantly changing." - Daniel Zarrilli

Since both the climate and climate science is constantly evolving, the NPCC scientists found that it was difficult to update the climate science for decision-makers without creating a sense of whiplash. It became difficult to introduce and socialize additional scientific understanding that was new to many agencies and individuals, in between the punctuated NPCC projection and assessment cycles.

"The NPCC did not cover everything, especially at the beginning" - Thomas Matte

NPCC1 overlooked certain critical aspects to climate change and New York City, in particular public health, community resilience, and equity, that are all essential to understanding climate change impacts. Later iterations of the NPCC addressed these lacunae: NPCC2 contained a public health chapter, which discussed community engagement. NPCC3 addressed public

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health, but did not have a stand-alone public health chapter. NPCC3 included a chapter on community resilience and equity, and NPCC4 contained chapters on both public health and climate equity.

"Finding the right policy priorities and the science and aligning the timescales of those things can get difficult." - Daniel Zarrilli

After Hurricane Sandy, city agencies were under immense pressure to produce "A Stronger, More Resilient New York" (SIRR), which also placed high demand on scientists to produce updated projections. The City had set a specific date for the launch of the SIRR, in June 2013, and wanted the NPCC projections to be in place by that same time. The first test for the NPCC was to decide whether to create a whole new set of projections. While NPCC1 utilized CMIP3 data for the projections, CMIP5 data was newly available. After analyzing the new science, NPCC2 decided to create a new set of projections based on the newly released CMIP5 so that they could be taken into account for the rebuilding of New York City after Hurricane Sandy. This six-month time frame was challenging for the scientists to accomplish this herculean task.

Section 4 Conclusions and Recommendations

This paper addresses the questions: How did the NPCC come to be formed? What "enabling conditions" were present? Were there "prequels" and What were its major contributions to PlaNYC? The paper presents how the NPCC scenarios and projections were initially developed and used by the City, describes disconnects between what the scientific projections were able to encompass and what the City and infrastructure operators, in particular, wanted and needed, and how the demand for and supply of projections evolved.

In regard to New York's global leadership, Mayor Bloomberg played a large role in the development of the C40 Cities Climate Leadership Group that shared many of the lessons learned in New York to cities around the world. Another example is the Urban Climate Change Research Network (UCCRN), established at the time of the C40 Summit held in New York City in 2007. UCCRN brings together over 2,000 international climate change scientists, practitioners, and decision-makers to build upon the scientific rigor of NPCC, by producing city projections and climate assessment reports. The intertwined efforts of PlaNYC and the NPCC have made New York far more resilient to climate change, especially the changing extreme events of both today and tomorrow.

The legacy of the NPCC is to be found not just in the city's enhanced resilience itself, but also in the broader context of its leadership for cities and climate change around the world. In regard to the city's resilience, NPCC projections and PlaNYC frameworks were used in four large projects post-Hurricane Sandy: The East Side Coastal Resiliency, Brooklyn Bridge-Montgomery

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Coastal Resilience, Lower Manhattan Coastal Resilience, and Battery Park City Resilience Projects. Together, these projects total $3.1 billion in resilience investments (Rebuild by Design, 2026).

Looking ahead to ensure the long-term continuation of the NPCC, a group of NYC-based universities, led by The New School, are exploring a proposal to create a new consortium to strengthen the work of the NPCC. This includes formalizing the NPCC's administrative and fund-raising capacity while preserving its strong connection to the City of New York. Ensuring the stability of this essential work by the NPCC requires consistent and dedicated financial and administrative support, as well as proper compensation for members' efforts, and supporting communication functions with partner city agencies.

Recommendations

This analysis of the origins of the NPCC and its contributions to PlaNYC, including the interviews with NPCC scientists, New York City policymakers, and New York City practitioners, has led to a series of recommendations.

Recommendations for the NPCC

- Connect projections to economic and health outcomes to make reports universally relevant.
- Improve institutional support of the NPCC, allowing it to efficiently bridge across administrations with dedicated financial resources.
- Encourage scientists to communicate with the public and explain risks and results intuitively.
- Establish specific NPCC working groups, such as water practitioner-focused and transportation practitioner-focused, to place science into ideal decision-making frameworks. This should include highly interdisciplinary topics, such as AI and supply chains.
- Prioritize outreach to communities and stakeholders, especially vulnerable populations.

Recommendations for the City of New York

- Improve multilevel governance between federal, state, and city government.
- Strengthen interagency coordination to enhance climate planning and project implementation.
- Implement a coordinated, city-wide climate adaptation monitoring system.
- Approach climate resilience at a regional scale. New York City should actively include its metropolitan areas in climate mitigation and adaptation.
- Prioritize outreach to communities and stakeholders, especially vulnerable populations.

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Recommendations for Cities Globally

- Build ongoing university-city partnerships.
- Form working groups with at-risk communities.
- Engage with broader city networks.
- Develop and monitor metrics of intervention effectiveness.
- Avoid static one-off reports.
- Maintain regular communication with stakeholders.
- Embrace complexity and uncertainty in resilience planning.

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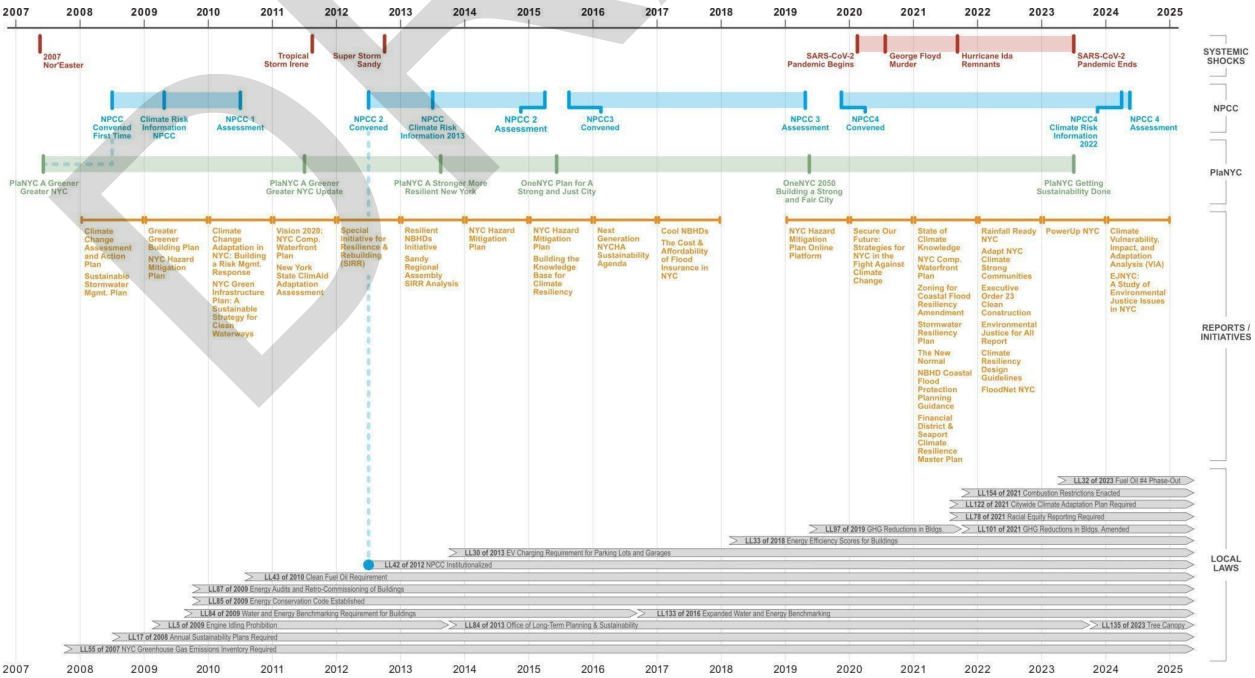
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Appendix 1. Archival Documents

Storage Unit #	Box Number	Box Label or Brief Description of Contents	Document Title(s)	Date	Contributors	Tags	Link to File
7.4.22	4	Dr. Hillel's Office	Hot Nights in the City: Global Warming and the New York Metropolitan Region	1999	David Major	Heat NYC	1999.5.27.4 Hot Nights in the City Executive Summary.pdf
7.3.20	100	Megan, NYC Adaptation Tech Committee, PlaNYC, NPCC NYC Studies, NYC Adaptation Tech Committee & London, US Reports, NYC DEP Reports 2007 &CDS	N/A	2005-2007	Megan Cornwell O'Grady	NPCC CCTF PlaNYC	2007.8.8.100.4.MTAStormReportjpg 2008.5.x.4.100 DEP Climate Assessment a... 2008.9.17.4.100 PlaNYC Inventory of NYC ... 2008.x.x.4.100 .jpg 2009.8.21.4.100 NPCC1 Assessment Repor... box 100.jpg box 100.jpg
7.3.20	101	NPCC2, AgMIP (PNAS)	N/A	2013	N/A	AgMIP NPCC UCCRN	2013.3.29.2.101 Phillip Orton NPCC2 Com... 2013.4.19.4.101 NPCC2 draft with notes.jpg 2013.11.15.4.101 UCCRN ARC3.2 Stakehold...
7.4.22	102	Climate Impacts Studies, Countries NPCC, NYC & cities 2000s	N/A	1990-2010	N/A	Not Tagged	2008.8.11.6.102.NPCC kickoff meeting brief... 2018.12.5.4.102 Celebrating 10 years of the...
7.3.20	102	Megan, NYC Panel on Climate Change 2008, Misc. Papers and reports	N/A	2007-2009, 2008	Megan Cornwell O'Grady, Radley Horton, Vivien Gornitz	NPCC IPCC	
7.3.20	103	ARCS, AgMIP, NPCC2, CCRUN, RISA, SDSN	N/A	2013	Jeff Sachs, Alex Ruane, Somayya Ali, Shagun Mehrotra, Stephen Hammer	AgMIP NPCC UCCRN	2011.12.16.8.103 Climate Change Impacts a... undated UCCRN stakeholder map box 103....
7.3.20	104	CASI, Green Roofs, GISS LEASE, GISS Reorg, CLIMAD, SDSN	N/A	2013	N/A	UCCRN	
7.3.20	106	Dr. Hillel's Cynthia's and Peter's Publications, CCSR NY Pubs.	N/A	2001, 2007-2008, 2010-2011	N/A	PlaNYC NPCC	2007.10.29.6.106. PlaNYC Deliverables Tim... 2007.x.x.6.106.NPCC Adaptation Technical... 2008.5.x.4.100 DEP Climate Assessment a... 2010.x.x.4.106.NPCC Summary.heic 2010.x.x.4.106.NPCC Summary.heic
7.3.20	107	Resilient Cities 2010, Deletion & Distribution 2012, AAAS Fellows 2012, UCCRN Hurricane Sandy 2012	N/A	2010-2012	N/A	UCCRN	
7.3.20	108	DEP/NPCC "Radley's Office" (4/5)	N/A	2002-2009	Radley Horton, David Tweety, Christina Stanton, David Major, John Taylor	NPCC	2008.8.27.4.108. NPCC T2 Climate Protecti... 2009.3.3.8.108.NPCC REPORT OUTLINE.pdf 2009.3.x.4.108.NPCC Chapter 5 Law and R...
7.3.20	172	MEC Report Documents	N/A	1999-2008	Kate Demong, Christina Stanton, David Major	Not Tagged	1999.1.19.2.172 Port Authority Stakeholder ... 2002.3.5.3.172 Metro East Coast Assessm... 2002.12.2.8.172.Proposed MEC Regional A... 2004.8.26.2.172.Chris Ward email formatio...

Appendix 2. NPCC Timeline (NPCC4).



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Appendix 3. PlaNYC 20 Interview Questions

1. a) What do you consider to be the NPCC's most important contribution to the City of New York's resilience planning efforts?

   b) How has the City integrated climate science into City policies?

2. Over time, city government stakeholders sought more spatially detailed and temporally specific climate information from the NPCC. New high-risk scenarios, such as the Antarctic Rapid Ice Melt (ARIM), emerged, and climate risks have increasingly extended beyond city boundaries, for example, Hurricane Sandy. What were the greatest challenges in balancing scientific rigor with the needs of city policymakers and critical infrastructure operators?

3. Looking ahead, what lessons from the NPCC experience should guide other cities seeking to build effective science-policy partnerships as they prepare for increasingly complex climate risks?

4. What elements of the foundational NPCC approach should be preserved, and what needs to be strengthened to better address cascading and compound risks, emerging climate challenges, and increased uncertainty?

5. Is there anything else you would like to add that was not discussed?

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Appendix 4. NPCC1 Members and Contributors

NPCC1 Members

Name	Affiliation at Time of NPCC 1
Cynthia Rosenzweig (Co-chair)	Climate Impacts Group, NASA Goddard Institute for Space Studies; Center for Climate Systems Research, Columbia University Earth Institute
William Solecki (Co-chair)	Institute for Sustainable Cities, CUNY Hunter College
Reginald Blake	Physics Department, New York City College of Technology, CUNY
Malcolm Bowman	School of Marine and Atmospheric Sciences, Stony Brook University
Andrew Castaldi	Swiss Reinsurance America Corporation
Craig Faris	Executive Partner, Risk Management, Accenture
Vivien Gornitz	Columbia University Center for Climate Systems Research
Klaus Jacob	Lamont-Doherty Earth Observatory, Columbia University
Alice LeBlanc	Environmental and Economic Consulting
Robin Leichenko	Department of Geography, Rutgers University
Edna Sussman	SussmanADR LLC
Gary Yohe	Department of Economics, Wesleyan University
Rae Zimmerman	Institute for Civil Infrastructure Systems, New York University

NPCC1 Non-Member Authors

Name	NPCC1 Paper Section of First Appearance	Affiliation at Time of NPCC 1
Michael R. Bloomberg	Foreword	Mayor, New York City
Jeffrey D. Sachs	Foreword	Director, the Earth Institute at Columbia University
Gillian M. Small	Foreword	Vice Chancellor for Research, The City University of New York
Radley Horton (Science Planning Team)	Chapter 3	Columbia University Center for Climate Systems Research
David C. Major (Science Planning Team)	Chapter 5	Columbia University Center for Climate Systems Research
Rachel Deming	Chapter 5	Scarola Ellis LLP
Pamela R. Esterman	Chapter 5	Sive Paget & Reisel PC
Adeeb Fadil	Chapter 5	Simpson Thacher & Bartlett LLP
Amy Fisher, Esq.	Chapter 5	Arnold & Porter LLP
Fred Fucci	Chapter 5	Arnold & Porter LLP
Roberta Gordon	Chapter 5	Bryan Cave LLP
Caroline Harris	Chapter 5	GoldmanHarris LLC
J. Kevin Healy	Chapter 5	Bryan Cave LLP
Cullen Howe	Chapter 5	Arnold & Porter LLP
Gail Port	Chapter 5	Proskauer Rose LLP
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Gail Suchman	Chapter 5	Stroock Stroock & Lavan LLP
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Appendix 5. Author Contributions

CR conceptualized the paper, developed methodology, conducted interviews, and drafted, reviewed, and edited the paper. WS conceptualized the paper, developed methodology, and reviewed and edited the paper. MD conceptualized the paper, analyzed and curated data, and reviewed and edited the paper. EA analyzed data and reviewed and edited the paper. DB contributed to scientific fact-checking and paper review.

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