How New York City is preparing for climate change

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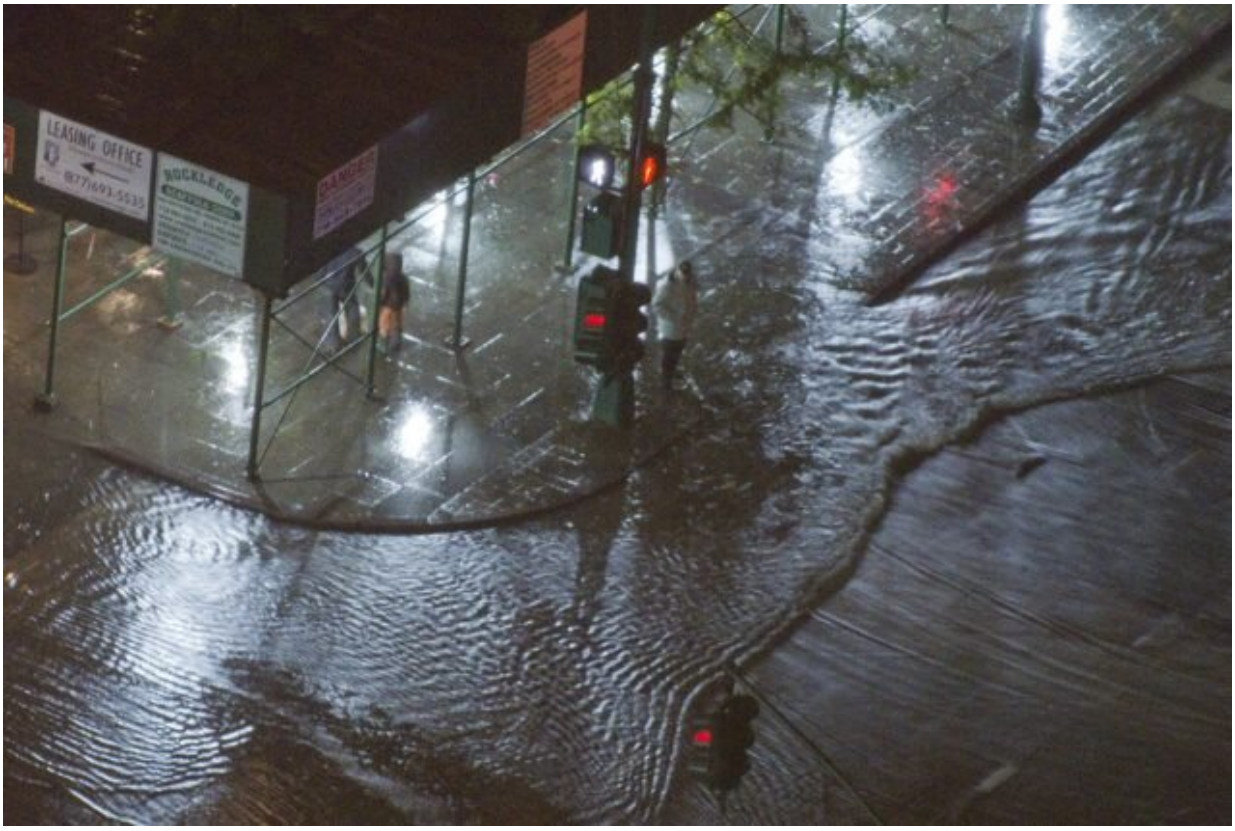

Credit: MTA

In 2008, New York City's Mayor Bloomberg brought together leading climate scientists, academics and members of the private sector to advise the city on adapting to the impacts of climate change. This group, called

the New York City Panel on Climate Change (NPCC), released its 2019 report in March. The report documents that local extreme weather events are becoming more frequent, longer lasting and more intense; temperatures in summer are getting hotter, and heavy downpours are increasing—changes that generally bear out the projections in the 2015 NPCC report.

NPCC's science-based findings and projections are used by the Mayor's Office of Recovery and Resiliency, which oversees OneNYC, New York City's $20 billion portfolio of programs to make the city more resilient to climate change. OneNYC's strategies include planning and policy studies, legislation, and investments in neighborhoods, buildings, critical infrastructure, and projects to protect the coasts.

"All of the City's resiliency efforts, ranging from our ambitious coastal protection projects to the Climate Resiliency Design Guidelines, are grounded in the NPCC's projections," said Phil Ortiz, a spokesperson for the Mayor's Office of Recovery and Resiliency, via email. He added that the projections shape citywide policies and regulations—such as zoning regulations that encourage flood-resilient building construction in coastal areas—as well as engineering decisions, such as how much drainage capacity to include in a project to mitigate flooding.

Here are just some of the measures the city has taken so far to prepare New York to meet the challenges of climate change. Many of them incorporate the NPCC's projections.

Designing for resilience

Climate Resiliency Design Guidelines

The NPCC's 2015 projections were used to produce the city's Climate Resiliency Design Guidelines, released in 2018. These nonmandatory

guidelines instruct architects, engineers and all those involved in the planning, engineering, construction and renovation of New York City buildings on how to design to deal with increased heat, precipitation and sea level rise, and make buildings more climate resilient.

"The guidelines are in the pilot stage," said Susanne DesRoches, deputy director for Infrastructure and Energy for the Mayor's Office of Recovery and Resiliency. "We are still advising agencies on how to use them." She explained that dealing with multiple climate hazards is a new approach for the design and engineering industries, which have traditionally relied on historical climate data. Now they are being asked to look at a project's useful life and map it to the climate projections for that time period. The guidelines provide a consistent overview on how to assess heat, precipitation and sea level rise for all the attributes of the facility being built.

"The resiliency design guidelines are what's actually needed to scale up implementation," said Cynthia Rosenzweig, co-chair of the NPCC and senior research scientist at the NASA Goddard Institute for Space Studies and the Earth Institute at Columbia University. "Otherwise we have a new project here, another project there, and each project would need to develop its own climate projections every single time. But the guidelines provide the nuts and bolts of the climate risk levels for all capital projects that the city undertakes." Moreover, the resiliency design guidelines are open and available for use by any project in the city. "I have been at other events focused on architects, engineers and landscape architects, and they are very positive about what the city has done by providing these design guidelines."

The design guidelines provide criteria to follow depending on the projected life of the building, the anticipated climate impacts and the location. For example, some areas of the city become especially hot in the summer because there is little shade and buildings are dense. Where

this urban heat island effect is severe, designers should consider both how their buildings will worsen the heat and how they can withstand the heat. To lessen a building's contribution of heat, the guidelines suggest using light colored and reflective surfaces in building materials and on roofs, improving building insulation, increasing shade by planting trees and other plants, installing a green or blue roof (the latter is designed to store rainfall), and using other permeable surfaces that can retain moisture. To withstand the heat, heating and cooling systems should be assessed for durability; backup power systems might be needed, and passive solar cooling and ventilation is recommended.

Sea level rise and the risk of tidal flooding need to be taken into consideration for all city buildings, especially those sited in current or future floodplains. If the risk is high, the building should be relocated. Otherwise, design strategies include constructing floodwalls or deployable flood barriers at the site, using natural systems such as restored wetlands, employing water-resistant materials, elevating critical systems, installing sump pumps, protecting underground telecommunications systems from damage, and providing backup power.

Rebuild by Design

Designing for resilience was also the basis of Rebuild by Design, launched by the U.S. Department of Housing and Urban Development in 2013 in response to Superstorm Sandy. The initiative began as a competition to find innovative and collaborative ways to make the areas devastated by Sandy more resilient to future climate impacts. One winning project was the Big U, an ambitious plan to protect Lower Manhattan from flooding from West 57th Street down to The Battery and back up to East 42nd Street by elevating parks that line the east side of Manhattan, developing a berm (or levees) and deployable flood walls or raising the land in the parkland to keep river water from overflowing.

The Big U

Unfortunately, groundbreaking on the Big U has been delayed and aspects of it have been cut due to lack of funds. However, Mayor de Blasio recently laid out a $10 billion plan to flood-proof Lower Manhattan where flood protection on land is not possible by extending the coastline out around two city blocks, as high as 20 feet above sea level in some places.

Redesigned flood maps and zones

Michael Marella, director of Waterfront and Open Space Planning for the NYC Department of City Planning, explained that the city's Flood Hazard Mapper provides the public with maps of today's flood risks as defined by FEMA and future flood risk in the 2050s, 2080s and 2100 based on NPCC's projections. This tool informs the public about the flood risks their homes and neighborhoods may face going forward.

Because Superstorm Sandy devastated areas of Staten Island and Queens, the Department of City Planning established Special Coastal Risk Districts, taking into consideration the NPCC projections. This redesigned zoning limits development in vulnerable areas of Staten Island, and in Hamilton Beach and Broad Channel, Queens. The department is also updating the city's flood resilience zoning rules to permanently regulate future development in the floodplain. And new preliminary flood insurance rate maps are being drawn up to determine flood insurance requirements in the light of increased flood risk from climate change and sea level rise.

Flooding, however, could increase beyond current projections; recent research suggests that sea levels may rise more later this century than previously thought due to rapid ice melting in the Antarctic. To integrate

this low-probability but significant risk, NPCC developed the Antarctic Rapid Ice Melt Scenario, which projects the effects of a higher sea level rise of 6.75 feet in the 2080s and 9.5 feet by 2100. The 2019 NPCC report presents two new coastal flooding maps that incorporate this high-risk scenario.

Dealing with the heat

To lessen the urban heat island effect, the NYC Cool Roofs program, begun in 2009, transformed over 6.7 million square feet of roof into cool roofs—green roofs and lighter colored roofs that reflect heat.

Moreover, the city's recently passed Climate Mobilization Act requires green roofs to be installed on all new residential and commercial buildings and increases the tax abatement for their installation. Meanwhile, the city's Department of Transportation has been converting dark pavement to lighter colored pavement, which reflects more of the sun's heat than dark asphalt, and has increased plantings to add shade and retain moisture.

By 2015, the $106 million Cool Neighborhoods initiative had planted over a million trees to control summer heat and it has allotted an additional $82 million to plant trees in vulnerable neighborhoods in the South Bronx, Northern Manhattan and Central Brooklyn.

And since 2011, the city's Department of Environmental Protection has been installing green infrastructure to help manage stormwater, beautify neighborhoods and provide shade for cooling. It has already created thousands of rain gardens and vegetated areas in the city, and aims to invest $1.5 billion in green infrastructure by 2030.

Rebuilding better

NYC Build it Back has helped almost 32,000 households damaged by Superstorm Sandy rebuild. Residents received reimbursement, construction help or buyouts. Over 9,000 units have been rebuilt with resiliency measures such as elevated utilities, backup power generation, energy efficiency strategies, and flood-proofing.

The RISE: NYC program helps small businesses impacted by Sandy prepare for the effects of climate change. It ran a competition to identify projects that would use new technologies and solutions to strengthen building systems, energy infrastructure and telecommunications networks in businesses that were damaged by Superstorm Sandy or are located in the 100-year floodplain. Thirty million dollars were awarded to 11 winning projects. For example, one RISE: NYC winner, Geosyntec Consultants, uses a new technology to monitor real-time flood data on the internet and activate valves installed in plumbing systems to prevent utility systems from flooding.

Protecting critical systems

The Metropolitan Transit Authority created a Recovery and Resiliency Division to repair damage that had been done to the subway system by Sandy and harden it against future climate impacts. The subway system has 3,600 openings that can be flooded—stairways, escalators, elevators, grates, and manholes. The MTA worked with companies to develop covers that could be stored onsite and quickly rolled out before a storm to cover stairways.

It also created huge tunnel plugs, added new pumps at the South Ferry Station, installed elevated subway grates on sidewalks, and built a 40-foot-tall floodwall sunk 30 feet underground along Jamaica Bay where the A line was damaged.

Superstorm Sandy knocked out power to 1.1 million Con Edison

customers in NYC. In response, Con Ed invested $1 billion into hardening its systems and making them more resilient. Its storm-proofing includes Kevlar sheets to keep water out, perimeter walls at stations, shrink wrap to protect panels, high-capacity pumps, elevated controls, new breakers so that transformers can be individually shut down, and fiber optic wiring.

Preparing for increased coastal flooding

The city's Waterfront Revitalization Program policies now incorporate the coastal flooding risks based on NPCC's projections. Waterfront projects that require public spending or certain types of permits must recognize the likely flooding risks, and either address them at the start or show how the project can be retrofitted over time.

The city has invested over $3.7 billion to protect the coast from flooding since 2015. Interim Flood Protection Measures are shoring up neighborhoods and critical facilities from coastal flooding until more permanent flood control measures are completed. Some of the strategies include walls of large, sand-filled containers made of permeable fabric, long tubes filled with water that serve as dams, and flood panels, stackable barriers that can close any openings into buildings when there's a risk of flood.

"Managed retreat" was the solution in some communities damaged by Sandy, such as Oakwood Beach and Ocean Breeze on Staten Island. Instead of being rebuilt, some houses were purchased by the state, demolished, and the areas around them have been turned into parkland.

Other beaches along Staten Island, Queens, and Brooklyn have been restocked with sand; concrete walls, boulders, dunes, and plantings have been installed along with sea walls; and the Rockaway Beach boardwalk has been replaced by a huge elevated retaining wall made with materials

that can withstand extreme weather.

Cutting global warming emissions

Because the largest share of NYC's greenhouse gases come from its more than one million buildings, city buildings over 10,000 square feet must measure and report their total energy use each year. So far, city agencies have received over $480 million for energy efficiency projects that are projected to avoid 176,000 metric tons of greenhouse gas emissions, equivalent to almost 38,000 vehicles being removed from the road. The NYC Retrofit Accelerator helps private building owners identify energy saving opportunities and has helped over 400 buildings convert from #4 heating oil to cleaner fuels; another 850 buildings are in the process of converting.

The new Climate Mobilization Act includes legislation requiring all buildings (except places of worship and rent-regulated housing) over 25,000 square feet to limit their emissions. Affecting about 50,000 city buildings, this bill is the first anywhere in the world requiring buildings to cap their emissions. In 2024, buildings will have to be retrofitted with insulated windows, heating systems and insulation that cut emissions by 40 percent relative to 2005 levels by 2030, and 80 percent by 2050. Violators will face steep fines for each ton of emissions over the limit.

In addition, the Climate Mobilization Act includes a mandate for the city to study the feasibility of shutting down all oil and gas burning power plants within city limits and replacing them with renewable resources and battery storage. The act also includes a loan program for renewable energy and a change in the building code to facilitate the installation of wind turbines.

As of 2018, the city had installed more than 10 megawatts of solar power on 57 city buildings, and aims to reach 100 MW by 2025. Solarize

NYC, a group purchasing campaign, makes purchasing solar energy easier in Harlem and Brownsville, Brooklyn.

The NYC Carbon Challenge is a voluntary program involving over 100 private companies, institutions and nonprofit organizations that have committed to reduce their greenhouse gas emissions by 30 to 50 percent over ten years. The mayor's office provides them with support and resources to achieve this. So far, they have reduced emissions by 600,000 metric tons of CO_2 with the goal to achieve 1.5 million metric tons—equal to removing 300,000 cars off the road.

The NYC Clean Fleet program, with the goal of halving vehicle emissions by 2025 and reducing them 80 percent by 2035, runs more than 18,500 city vehicles with cleaner fuels such as biodiesel, electric, natural gas, hybrids and solar power. The city aims to eliminate fossil fuel-based diesel altogether. City agencies currently use over 1,200 electric vehicles that can be charged at 500 charging stations throughout the city.

A congestion pricing plan set to begin in 2021, is expected to be approved soon, and will make New York City the first American city to introduce congestion pricing. By charging drivers money to enter the busiest parts of the city, it will cut emissions from the transportation sector and reduce air pollution. The money collected will go towards improving public transportation—the Long Island Railroad, Metro North and the city's subway and buses.

What's next for the NPCC and the city?

Rosenzweig said that as soon as its 2019 report came out, the NPCC started thinking about where it should go with the next report. The main focus areas will depend on what the city feels it needs for decision-making, and what's emerging in the science. "The science part that I

would bring forward is the potential for joint hazards of extreme events," said Rosenzweig. "For example, there is increasing risk of a heat wave that brings on a blackout followed by a heavy rainstorm that causes flooding, and the result is there is no electricity to run the pumps to deal with the excess water. What we need to do is start looking at the joint probabilities of these sequential hazards or simultaneous hazards and their impacts.'"

To help understand these combined hazards and their potential impacts, the NPCC has proposed that the city create a centralized and coordinated system to track climate change indicators from data collection agencies and processing centers, decision makers, policies, projects and programs. The system would monitor trends in climate and their impacts, and be able to facilitate needed changes in policy and goals for climate change adaptation and resiliency.

New York City also expects to make the Climate Resiliency Design Guidelines mandatory, at least for city agency use, said DesRoches. "I don't have a timeline for that, but as we learn more about how this changes design, we will be able to better understand the costs associated with incorporating resiliency attributes as well as the benefits of those."

She believes the guidelines will shift the conversation in the overall engineering industry from relying on historical data to being able to take the uncertainty in climate projections and build to those numbers. "It's also about New York taking a leadership role in pushing the design and engineering industry to think more broadly."

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