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THE GREEN OPPORTUNITY IN NEW YORK CITY'S HISTORIC BUILDINGS

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IN THIS ISSUE

New York City's old and historic buildings provide a vast opportunity for energy savings that can make a remarkable contribution toward the mitigation of climate change. There is a common perception that historic buildings are inefficient or even "energy hogs." While there is a dearth of data on this issue, older buildings, built before cheap energy and the availability of mechanical systems, tend to incorporate many sustainable features that make them relatively efficient. In addition to being designed in response to local climates, old buildings are constructed out of locally sourced, renewable materials, with operable windows for natural ventilation, awnings to supply shade, and cisterns for collecting rainwater. Many of these traditional buildings practices have resurfaced as new green building techniques.

Historic buildings are a small subset of New York City's existing older buildings. Roughly 55 percent of the city's 838,337 buildings were built before 1940.[1] Locally designated buildings make up roughly 3.2 percent of the total building stock, totaling approximately 27,000 buildings under the Landmarks Preservation Commission's (LPC) jurisdiction. This number includes 118 historic districts and 1,279 individual landmarks.[2] In New York City, historic buildings are designated and regulated at the local, state and federal level.[3] It is important to recognize that, when it comes to energy use, historic buildings are only different from the city's older buildings in that they have a regulatory overlay.[4] Otherwise, they share the same relative built-in efficiency, the same potential for energy gains, and the same risks for inappropriate work harming their durability.

[1] This data is from 2008 version of the New York City Department of City Planning's MapPLUTO. 470,440 of the city's 838,337 buildings were built prior to 1940, although this count only includes properties that indicate a date of construction.

[2] As of February 15, 2011, this number included 1,279 individual landmarks, 111 interior landmarks, 10 scenic landmarks, 102 historic districts and 16 historic district extensions in all five boroughs.

[3] *See* Christopher Rizzo, "Historic Preservation Law 101 for New York Lawyers," *The New York Environmental Lawyer* (Spring 2009, Vol. 29 No. 2).

[4] LPC is responsible for identifying and designating the City's landmarks and historic districts and regulating changes to those buildings. The National Register of Historic Places, created by federal law in 1966 as part of the National Historic Preservation Act, is a list of buildings, structures, sites and objects that are significant in American history, architecture, engineering or culture. In New York, that program is administered through the State Historic Preservation Office (SHPO), which also administers the New York State Historic Preservation Act of 1980. Many, but not all, New York City-designated buildings are also listed on the National Register.

I. Introduction

The building sector is by far New York City's largest consumer of energy. In 2008, 75% of New York City's greenhouse gas emissions resulted from energy used in the construction and operation of buildings.[5] The city's sustainability plan, PlaNYC, prioritizes improving the performance of the city's buildings. Any strategy to fight climate change—especially in New York City—must address how we can better manage and operate our existing buildings, especially our older buildings. Given that the majority of the city's building stock was constructed before 1940, preservationists, with their expertise in dealing with older buildings, can and should play a role in developing solutions.

With the urgent need to tackle climate change, the Municipal Art Society of New York (MAS) is increasingly focusing on how it can imbue its planning and preservation practices with an environmental ethic. MAS launched the Preservation and Climate Change campaign to promote the positive environmental benefits of preserving and improving the efficiency of New York's older and historic buildings.[6] In the winter of 2010, MAS hosted eight roundtable discussions with an interdisciplinary group of experts in order to find common ground between the goals of historic preservation, urban sustainability, green building and climate change policies. In addition, in October 2010, MAS and Columbia University's Graduate School of Architecture, Planning and Preservation co-hosted the Conference on Preservation and Climate Change in New York City.

Historically sensitive energy retrofits can be complex, but there are numerous examples of historic buildings that are being improved without compromising their character. One of the finest art deco office buildings in New England is Boston's McCormack Building, and home to an Environmental Protection Agency office. The building underwent a green retrofit in which all mechanical and electrical components of the original building were removed, but an impressive 99 percent of the original structure was retained, including interior features such as historical paneling and oak parquet floors. The National Register-eligible building achieved a Gold certification under the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) for new construction (NC) version 2.2. It substantially improved its energy efficiency, cut water usage by 32 percent, and made the building a more pleasant work environment.[7]

The LPC has also approved significant green retrofits. A rowhouse in Brooklyn's Park Slope Historic District was restored and retrofit to Passive House standards, an approach to design and construction that dramatically reduces the energy used to operate a building through insulation and making the building virtually air-tight. The LPC also approved the addition of photovoltaics on the roof of City Hall, a landmarked building built between 1802–1811.[8]

II. Greening Historic Buildings

An array of environmentally sound measures can be applied to historic buildings to make them greener, such as using sustainable materials like environmentally-friendly carpets and improving indoor air quality. However, with the urgent need to reduce the country's greenhouse gas emissions, it is critical to focus on how historic buildings can become more energy efficient. A recent McKinsey & Company report stated, "[e]nergy efficiency offers a vast, low-cost energy resource for the U.S. economy, but only if the nation can craft a comprehensive and innovative approach to unlock it."[9] Historic buildings can, and should, become more efficient, along with all of New York City's buildings. Improving efficiency doesn't always require changes that conflict with preservation standards, and major performance improvements can be made through capturing maintenance opportunities and improving operations.

A. LEED

The LEED building rating system is the most well known third-party green building rating system in the country. While there are a number of LEED-certified historic buildings in New York City—from the International Toy Center to the Lion House at the Bronx Zoo—LEED remains passionately debated in the preservation community. Many practitioners are concerned about LEED's focus on new construction and the low number of points awarded for retaining an existing building. In the last few years, the USGBC has been receptive to making changes to the LEED system to better diminish conflicts between historic buildings. However, the expense and complicated nature of the program limit its wide application. As of January 2011, there were only 146 LEED certified buildings and 646 registered buildings in New York City, largely in Manhattan.[10]

B. New York City's Greener, Greater Buildings Plan

In December 2009, New York City Mayor Michael Bloomberg signed four legislative components of the Greener, Greater Buildings Plan, which address the critical area of energy use in

[5] *See* "New York City's Greener Greater Buildings Plan," *available at* http://www.nyc.gov/html/planyc2030/html/plan/buildings_plan.shtml.

[6] The campaign is supported by funding from the New York Community Trust, the National Endowment for the Arts, the J.M. Kaplan Fund and the National Trust for Historic Preservation.

[7] Information about the McCormack Building is available at http://www.epa.gov/oaintrnt/documents/boston_508.pdf.

[8] *See* Landmarks Preservation Commission Binding Report (Docket # 10-7128).

[9] McKinsey & Company, *Unlocking Energy Efficiency in the U.S. Economy* (July 2009), *available at* http://www.mckinsey.com/clientservice/electricpowernaturalgas/us_energy_efficiency.

[10] A full list of LEED certified and registered projects is available at https://www.usgbc.org/ShowFile.aspx?DocumentID=8784.

existing buildings. The plan establishes, among other things, a New York City energy code, which unlike the state energy code in existence at the time applies to all construction projects rather than just projects where more than 50% of the building subsystems are being renovated. The plan also requires large buildings to record and make publicly available annual energy usage through benchmarking, conduct building energy audits every ten years, and carry out building retro-commissioning to "tune up" building systems.[11] EPA's Energy Star Portfolio Manager is used to satisfy the benchmarking requirement.[12] While the new energy code applies to buildings of all sizes, the other parts of the plan apply only to buildings over 50,000 square feet. There are about 24,000 such buildings in New York City and they constitute roughly half of citywide square footage and are responsible for 45% of citywide greenhouse gas emissions, while buildings under 50,000 square feet and transportation are responsible for 32% and 23% of emissions respectively.

Many of the regulations in the Greener, Greater Buildings Plan are directed at gathering and sharing information about building performance, which can be positive for understanding the city's older buildings. Because older buildings were constructed before widespread use of mechanical systems, they were designed to work with nature to provide cooling, ventilation and lighting without the use of any fossil fuels. These design features can help make some of these older existing buildings perform as well or better than even new energy efficient construction. Data from the U.S. Energy Information Agency indicates that pre-1940s and especially pre-1920s buildings perform as well or better than even new energy efficient construction.[13] Comprehensive data collection on the performance of the city's historic buildings through benchmarking will likely show their relative efficiency when compared to newer buildings. The other elements of the Greener, Greater Buildings Plan, requiring energy audits and retro-commissioning every ten years, are likely to have few negative impacts on the architectural features of historic resources. This is because the retro-commissioning requires a tune-up of a building's systems, like the boiler, and does not affect the architectural features of a building, and the audit does not trigger any requirements for work identified in the audit to be performed. While many of the city's historic buildings are less than 50,000 square feet and thus exempt them from many of the plan's requirements, it is possible that that this size restriction will change in the future.

The city's new energy code explicitly addresses the city's historic resources. Like the State's 2010 New York State Energy Conservation Construction Code, the city's energy code exempts State- and National Register-listed historic buildings (exemptions for locally designated buildings were removed from the State's code in 2010). New York City-designated individual landmarks and buildings located in historic districts are subject to the code, but there are exemptions from the envelope and exterior lighting requirements and interior landmarks are entirely exempt.[14] While the changes were meant to bring historic buildings into the fold, in practice many buildings are still exempt because there is considerable overlap between State and National Register buildings and designated landmarks.

Further research needs to be done to identify conflicts between energy codes and preservation standards, and how they can be alleviated. Current energy codes were initially written to address new construction, making their application to existing buildings more challenging. Because the application of energy codes to historic buildings is so recent in New York City, there are not many case studies. One recent application to the LPC highlighted a conflict between preservation standards and the energy code, which was ultimately alleviated through an exemption. The Manufacturers Trust Building, an extremely significant mid-century modern bank on Fifth Avenue and 43rd Street, was designed by Gordon Bunshaft of Skidmore Owings and Merrill. The small glass building has been designated a landmark for a decade, and just recently designated an interior landmark as well. One of the character-defining features of the landmark is an illuminated ceiling. In developing plans to put a new use in the building, the lighting levels of the ceiling were found not to meet the city code, which required lighting changes that would have negatively impacted the preservation of the building's interiors. However, because of the interior's landmark designation and eligibility for listing on the National Register, it was exempt from the energy code. It is possible that aesthetic conflicts are more likely to arise with unique building types, modern buildings, and interior landmarks. The more urgent concern is how codes will impact the durability and inherent efficiency of old buildings.

C. Energy Retrofits and Durability

For preservation, building energy codes can be a blunt tool, prescribing solutions that may not always take into consideration the architectural quality of a historic building, or its innate passive systems. Passive design features—such as natural ventilation, passive air flow systems, daylighting, thermal mass, among others—can be fundamental to the performance of some existing buildings but are often overlooked in codes.[15] In addition, some incorrectly applied alterations meant to improve building performance could negatively impact the durability of historic buildings. This is particularly true with regard to the addition of thermal insulation to older buildings

[11] Information about the Greener, Greater Buildings Plan is available at http://www.nyc.gov/html/planyc2030/html/plan/buildings_plan.shtml.

[12] Information about Energy Star Portfolio Manager is available at http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

[13] *See* U.S. Energy Information Agency, "Consumption of Gross Energy Intensity for Sum of Major Fuels for Non-Mall Buildings" (2003). *available at* http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/2003set9/2003pdf/c3.pdf.

[14] *See* City of New York Local Law No. 85. *available at* http://www.nyc.gov/html/planyc2030/downloads/pdf/ll85of2009_energy_code.pdf.

[15] *See* Sean Dennisto, "Toward a Future Model Energy Code for Existing and Historic Buildings," *available at* http://eec.ucdavis.edu/ACEEE/2010/data/papers/2188.pdf. Page 8-95.

with solid masonry walls. Because of New York City's cold climate conditions, improperly insulating walls can change the building's moisture balance and increase the risk for condensation and frost inside the wall, which can negatively impact the durability of the building envelope.[16] In some cases changes in mechanical systems and even windows can change the way moisture interacts with a building's envelope.[17] Durability and energy efficiency are the cornerstones of sustainability, and a building's durability should not be sacrificed to make energy gains. Building science experts need to guide decisions related to codes, and trained architects, engineers and professionals experienced in working with historic building need to have authority in making the appropriate decision for a building.

D. A New Approach to Codes

The regulatory challenge is to develop a system that maximizes efficiency gains while minimizing impacts to old and historic buildings. The Preservation Green Lab, a project of the National Trust for Historic Preservation, is working on doing just that.[18] Along with the New Building Institute and the City of Seattle, the Lab is developing a new outcome-based energy code to improve the performance of existing buildings. This pilot project is intended to be a national model for jurisdictions to provide code flexibility while also aggressively pursuing reductions in greenhouse gas emissions.

The Lab's plan addresses the shortcomings of relying on energy codes to achieve widespread energy gains, while recognizing that the path to achieving greater efficiency for historic buildings should not be overly prescriptive. The Lab has found that energy codes do not encourage widespread retrofits, because compliance is only required when buildings go through a permitting process. It has also found that:

> [energy codes'] "one size fits all" approach does not recognize the inherent passive strengths of individual buildings, and at the same time often creates challenges for historic buildings by prescribing changes that can compromise their architectural character and detract from their economic value. The majority of building energy consumption is determined by how buildings are operated and occupied, yet today's energy codes focus only on building design.[19]

Through outcome-based codes owners can invest in measures that will create the most energy savings for that particular building.

In the near-term, Seattle is considering making outcome-based codes a voluntary, alternate code path, which would not completely replace the energy code. It is now undertaking demonstration projects that will help create methodologies and metrics for setting performance metrics. Historic buildings would be eligible for the alternate path, along with buildings that are undergoing a change in use and small buildings. The Green Lab will wait for the alternate path to be available before recommending the removal of the energy code's exemption for National Register Buildings.[20]

E. MAS Demonstration Project

In order to demonstrate how to improve the performance of a historic building, MAS will work with the Henry Street Settlement to sensitively improve its headquarters at 263, 265, 267 Henry Street, in Manhattan's Lower East Side. Funded through a challenge grant from the J.M. Kaplan Fund, the project's goal is to show policymakers and the general public how to make efficiency gains and lower operating costs without compromising architectural character or impacting durability. The Settlement's federal-style buildings are ideal for the demonstration project because of their age, relative lack of alterations and, in terms of size and configuration, ubiquity in New York City. The project has just started, and MAS and its consultants from the Pratt Center, Thornton Tomasetti, and Li/Saltzman Architects are developing the scope of work. MAS anticipates that a modest investment in initial implementation measures will lead to a 25 percent annual energy savings. MAS will also be working with the LPC on a manual explaining how to make efficiency improvements to designated buildings. The manual will provide building owners accessible, actionable and preservation-friendly means to reduce energy usage.

III. Measuring Building Efficiency Gains and Building Reuse

Metrics are critical in determining which measures most effectively improve energy efficiency and are necessary to demonstrate that reusing old buildings is good for the environment. Thus, there is a great need for accurate data regarding the energy efficiency of older buildings, metrics on building components like replacement windows, and data that quantifies building reuse and which takes into consideration the environmental impacts of all phases of a building's life, including operation, demolition and new construction.

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[16] *See* Mario D. Gonçalves, "Insulating Solid Masonry Walls" at 2, *available at* http://www.patenaude-trempe.info/PDF/NBEC_EN_Insulating_Solid_Masonry_Walls.pdf.

[17] *See* Jean Carroon, *Sustainable Preservation: Greening Existing Buildings* at 220 (Wiley Nov. 2010).

[18] Information about Preservation Green Lab is available at http://www.preservationnation.org/issues/sustainability/green-lab.

[19] *See* Preservation Green Lab, "Outcome-Based Energy Codes for Existing Buildings" (Nat. Trust for Historic Buildings, New Buildings Institute, and City of Seattle Oct. 2010), *available at* http://www.preservationnation.org/issues/sustainability/green-lab/additional-resources/Seattle-Outcome-Based-Energy-Codes-Report.pdf.

[20] *See id.*

A major effort is underway in the public and nonprofit sectors to collect data on energy use in existing buildings. As explained above, the Greener, Greater Buildings Plan will allow the city to collect a large pool of information about the performance of buildings over 50,000 square feet. However, because of their historic designation and/or size, many historic buildings are exempt from the program and are thus exempt from having to benchmark and report their energy use. To understand how older buildings perform compared to newer ones, there needs to be more benchmarking and data collection with respect to historic buildings, and MAS and other organizations are urging that the date of construction be used as a data point. In the near-term, the trigger for such data collection would likely be through the use of financial incentives offered by the New York State Energy Research and Development Agency (NYSERDA) or other non-profit or government agencies. EPA's Portfolio Manager for benchmarking, which New York City uses in its benchmarking law, includes the date of construction.

One of the most compelling arguments for retaining existing buildings is drawn from life cycle analysis (LCA), which accounts for the energy expenditures of construction, operation and demolition. For example, a study by the United Kingdom's Empty Homes Agency found that it takes 35–50 years for a new energy-efficient single-family home to recover the carbon expended during its construction."[21]

The National Trust is studying ways to improve LCA to better quantify the environmental value of building reuse. The goals of its study are to compare the environmental impacts of retention and rehabilitation versus demolition and new construction, and identify the conditions when it is advantageous to retain a building instead of constructing a new one.[22] One of the major issues in the study concerns embodied energy. Embodied energy is the energy that is expended in a building's construction, including the manufacturing of the materials. However, because this energy has been expended in the past, it is difficult to convince many in the environmental community of its importance given the focus on reducing future energy expenditures. However, embodied energy is an avoidable loss of a scarce resource and should not be completely discounted.

IV. Construction and Demolition Waste

An important issue to preservationists is avoiding demolition, although it is an issue that should also be important to environmentalists. Developing metrics concerning demolition is difficult because the carbon impacts of demolition are under recognized and understudied. New York City generates roughly 10 million tons of construction and demolition (C&D) debris annually,[23] which makes up about 60 percent of the city's waste stream, above the national average for municipalities of between 25–40 percent.[24] MAS has quantified and mapped demolition permits issued in New York City from 2003 to 2008. During that five-year period, 16,567 permits were issued for demolition, the equivalent of approximately 2 percent of the city's building stock.

Since New York City closed Fresh Kills landfill on Staten Island, this waste must be trucked to waste transfer stations where some of the materials are recycled and others are trucked or barged to landfills or incinerators in Mid-Atlantic states. Along with the demolition itself, the transportation of C&D debris to landfills releases greenhouse gas emissions. One state that has attempted to address this issue is California. Many jurisdictions in the state have passed local ordinances that require applicants to submit a waste management and recycling plan in order to receive a demolition permit, along with a fee that is refunded only if the recycling targets are met.[25]

V. Planning for Population Growth in New York City

Elected officials, academic institutions, non-profit groups and policymakers have created a number of important plans, policies and financial incentives directed at reducing the city's greenhouse gas emissions. Most notably, PlaNYC—a comprehensive sustainability framework for the city's growth—has brought environmental issues to the forefront of urban thinking.[26] Infusing these plans with thoughtful preservation-oriented policies can help further a holistic sustainability agenda.

There is a perceived conflict between historic preservation and overall urban sustainability goals—namely accommodating population growth and densification while at the same time preserving existing building stock. PlaNYC makes clear the need to plan for an increase in density to accommodate an expected population increase of one million people by 2030. Historic preservation can be part of this plan. For example, historic neighborhoods tend to be located near transit centers, and many have amenities that make them attractive places to live and site affordable housing. In addition, there are many

[21] *See* Richard Moe Speech, "Sustainable Stewardship of the Built Environment," *available at* http://www.preservationnation.org/about-us/press-center/soe/speeches/into-2009.html.

[22] Patrice Frey, "The Building Envelope and Beyond: Understanding the Environmental Value of Older and Historic Building Conservation," Presentation at MAS Conference on Preservation and Climate Change in New York City (Oct. 16, 2010).

[23] *See* New York City Department Of Sanitation, "Comprehensive Solid Waste Management Plan" (Feb. 2006), *available at* http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/swmpweb.pdf.

[24] *See* New York City Dept. of Design & Construction, "Construction & Demolition Waste Manual" (May 2003), *available at* http://www.nyc.gov/html/ddc/downloads/pdf/waste.pdf.

[25] *See* California Department of Resources Recycling and Recovery, "Construction and Demolition (C&D) Diversion Informational Guide," *available at* http://www.calrecycle.ca.gov/LGCentral/Library/CandDModel/Default.htm.

[26] Information about PlaNYC is available at http://www.nyc.gov/html/planyc2030/html/home/home.shtml.

non-historic areas where new buildings can be located. For example, even with historic and zoning districts that preserve low-density neighborhoods in certain parts of the city, MAS data shows that from 2003 to 2008 the gross square footage of the city's building stock increased by nearly 300 million square feet, roughly equivalent to the construction of 250 Chrysler Buildings in just a five year period.[27]

There are many ways in which preservation promotes a more sustainable city, and there is no reason we have to choose between protecting our historic resources and developing New York City. With comprehensive planning that allows for community participation, MAS is confident that we can create higher density affordable housing in an equitable manner while preserving the places that give New York City its identity and soul.

VI. Adapting to Climate Change

The impacts of climate change threaten the world's natural and built environments, especially the world's fragile heritage sites. Climate change will impact regions differently, from desertification in Africa to increased El Nino events in the Pacific. Given this reality, the preservation community should be engaged in identifying the impacts that climate change will have on historic and cultural resources and how to develop mitigation and adaptation plans atlocal and regional levels.

With 578 miles of waterfront, New York City is especially vulnerable to the impacts of climate change. Not only are sea levels expected to rise, but as temperatures increase, the city could be hit by stronger storms that could deluge many neighborhoods and destroy the city's low-lying historic, cultural and natural resources.

The Statue of Liberty National Monument, on Liberty Island, and Ellis Island were identified in a report by The Rocky Mountain Climate Organization and NRDC as among the 25 national parks and monuments most at risk because of climate change.[28] The report states that Ellis Island is "less than three feet above the current high tide level. The whole national monument ... is in substantial danger of being completely lost to higher seas. Even before being permanently inundated, the historic immigration center could be damaged or destroyed by storm surges."[29]

To assess the likely local climate change impacts on Gateway National Recreation Area in New York Harbor, the Intergovernmental Panel on Climate Change (IPCC), the Metro East Coast (MEC) Assessment, and the New York City Panel on Climate Change (NPCC) have provided data to the National Park Service (NPS) which issued a study on the issue.[30] The NPS found four climate change impacts that would significantly affect Gateway: sea level rise, precipitation changes, temperature changes and changes in the frequency or intensity of extreme weather events. The study specifically looked at the impact to historic resources and found that Fort Hancock's historic officer's row in Sandy Hook was the most vulnerable to sea level rise.[31] This information can be used by the NPS in future management plans to make difficult decisions about whether to restore certain buildings or even whether to move them.

Beyond flooding, the steady increase in temperature will cause problems for the city's building stock. Changes in freeze thaw-cycles, rising soil moisture and increased biological infestation will impact New York City buildings. In addition, the city's historic parks and landscapes will be affected by climate change. For example, increased temperatures have already allowed for some warmer-climate invasive species like kudzu, a fast-growing vine, to get a toehold in the region.

Finally, given the expected increase in severity and number of weather events, it is important than preservation be integrated into New York City's emergency plans. While the priority of local emergency plans is rightly focused on swiftly addressing basic human needs, preservation should play a role in later phases to ensure that the life and commerce of the city's neighborhoods can be quickly restored. Galveston, Texas, Minnesota and Florida have developed disaster plans for historic preservation.[32] One benefit of buildings built before widespread use of mechanical systems is that they have passive survivability, meaning they have design features that allow them to function without mechanical systems. In the case of widespread energy outages, older buildings with operable windows that allow for air circulation and day-lighting may be more habitable and comfortable than buildings dependant on mechanical systems for those features.

VII. Conclusion

Ultimately, the practice of historic preservation, and the field's ethic of retaining and repairing existing buildings and architectural features, is environmentally friendly. However, historic buildings can and should improve their energy efficiency. The key is an outcomes-based approach that maximizes efficiency gains while minimizing impacts to old and historic buildings.

[27] *See* 2008 version of the New York City Department of City Planning's MapPLUTO and New York City Department of Buildings monthly reports 2003–08. The monthly reports are available at http://www.nyc.gov/html/dob/html/guides/foilmonthly.shtml.

[28] The Rocky Mountain Climate Organization, "National Parks in Peril: The Threats of Climate Disruption" (2009), *available at* http://www.rockymountainclimate.org/website%20pictures/ParksInPeril_NY-NJFacts.pdf.

[29] *Id.* at 33.

[30] *See* Columbia University, "Long-term Resource Management Under a Changing Climate," *available at* http://www.columbia.edu/cu/mpaenvironment/pages/projects/spring09/GateClimChgReport.pdf.

[31] *Id.* at 25.

[32] *See* National Trust for Historic Preservation, "Preparing a Local Disaster Plan," *available at* http://www.preservationnation.org/resources/technical-assistance/disaster-recovery/preparing-a-local-plan.html.

More work needs to be done to develop metrics on the environmental value of retaining existing buildings, and on finding and promoting the common ground between preservation and the city's sustainability goals. Finally, the impacts of climate change on the city's historic and cultural resources need to be better understood, and strategies to adapt to those impacts need to be developed.

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