Decarbonization and Climate Resiliency Design Guide

Interim Guidance for New Buildings and Major Renovations

For New York State Affected Enitities

November 2024

NEW YORK STATE OF OPPORTUNITY | Office of General Services

NEW YORK STATE | NYSERDA New York State Energy Research and Development Authority

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Definitions

All-Electric: Buildings or systems that rely on electricity for heating, cooling, cooking, and other energy needs, without using fossil fuels.
Source: https://www.usgbc.org/articles/building-electrification-why-it-matters

BACnet Infrastructure: A data communication protocol for building automation and control network.
Source: https://bacnet.org/wp-content/uploads/sites/4/2022/06/BACnet-A-standard-communication-infrastructure-for-intelligent-buildings-1.pdf

Base Flood Elevation (BFE): The elevation of surface water resulting from a flood that has a 1% chance of equaling or exceeding that level in any given year.
Source:https://www.fema.gov/node/404233#:~:text=The%20elevation%20of%20surface%20water,level%20in%20any%20given%20year

Built Environment: The human-made surroundings that provide the setting for human activity. These include buildings, parks, infrastructure, and all other physical modifications to the natural environment where people live, work, and recreate.

Source: https://www.epa.gov/smm/basic-information-about-built-environment

Building Management System (BMS): A system that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems.

Source: https://www.sciencedirect.com/topics/engineering/building-management-system

Building Thermal Envelope: The exterior walls (above and below grade), floor, ceilings, roofs, and any other building element assemblies that enclose conditioned space or provide a boundary between conditioned and unconditioned space.

Source: https://up.codes/viewer/new_york/ny-energy-conservation-code-2020/chapter/CE_2/ce-definitions#CE_2

Climate Adaptation: Taking action to prepare for and adjust to both the current and projected impacts of climate change.

Source: https://www.epa.gov/climate-adaptation/climate-adaptation-and-epas-role

Cloudburst Management: A "cloudburst" is a sudden, heavy downpour where a lot of rain falls in a short amount of time. Cloudburst management implements a combination of methods that absorb, store, and transfer stormwater to minimize flooding from cloudburst events.

Source: https://www.nyc.gov/site/dep/environment/cloudburst.page

Decarbonization: The process of reducing carbon dioxide emissions by using low carbon power sources, increasing energy efficiency, and developing sustainable practices in industries, transportation, and energy sectors.

Demand Flexibility: Demand flexibility is the capacity of demand-side loads to change their consumption patterns hourly or on another timescale. This can help make electricity more affordable by helping customers use less power when prices are high.
Source: https://buildings.lbl.gov/demand-flexibility

Distributed Energy Resources: Small-scale units of local generation connected to the grid at distribution level, including solar panels, wind turbines, and energy storage systems.
Source: https://www.nrel.gov/docs/fy02osti/31570.pdf

Energy Management Information System (EMIS): A system that collects, stores, and analyzes energy-related data to optimize energy use and improve energy performance.
Source: https://www.energy.gov/femp/what-are-energy-management-information-systems

Energy Efficiency: Using less energy to perform the same task or produce the same result.
Source: https://www.energy.gov/eere/energy-efficiency-buildings-and-industry

Gas Baselines: The established, historic levels of gas usage against which future gas consumption is measured.

Greenhouse Gases (GHGs): Gases that trap heat in the atmosphere, which include carbon dioxide, methane, nitrous oxide, and fluorinated gases.
Source: https://www.epa.gov/green-power-markets/glossary

Green Infrastructure: A range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters.
Source: https://www.congress.gov/115/plaws/publ436/PLAW-115publ436.pdf

Low Impact Development (LID): Systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration, or use of stormwater in order to protect water quality and associated aquatic habitat.
Source: https://www.epa.gov/nps/nonpoint-source-urban-areas

NYStretch: A supplement to the 2020 Energy Conservation Construction Code of New York State (State Energy Code) available for voluntary adoption by local governments as a more stringent local energy code. On average, the NYStretch-2020 supplement improves the State Energy Code's efficacy by roughly 10% and is a model for New York jurisdictions to use to meet their energy and climate goals by accelerating the savings obtained through their local building energy codes.
Source: https://www.nyserda.ny.gov/All-Programs/Clean-Resilient-Building-Codes/NYStretch-Energy-Code-2020

Renewable Energy: Energy that comes from unlimited, naturally replenished resources, such as the sun, tides, and wind.

Source: https://www.energy.gov/eere/renewable-energy

Resilience: The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions. A climate resilient entity is one that is able to cope, adapt, and evolve in the face of current and future climate conditions, inclusive of both acute and chronic climate hazards.
Source: https://www.whitehouse.gov/wp-content/uploads/2023/09/National-Climate-Resilience-Framework-FINAL.pdf

Solar Ready Zone: A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

Source: https://codes.iccsafe.org/content/iecc2018/appendix-ca-solar-ready-zone-commercial

Sustainability: Meeting the needs of the present without compromising the ability of future generations to meet their own needs.
Source: https://www.epa.gov/sustainability/learn-about-sustainability

Zero Emissions Vehicles (ZEVs): Vehicles that produce no tailpipe emissions from the onboard source of power.
Source: https://afdc.energy.gov/laws/4249

1 Background

There is growing urgency to decarbonize the built environment while adapting to climate change, and New York State has committed to doing so to protect our communities and ensure a sustainable future. Direct emissions from buildings today account for roughly one-third of greenhouse gas emissions in New York State, driven primarily by fossil fuel-based space and hot water heating. If emissions attributable to generating the electricity used in buildings are added, that figure rises to over 40%.

Additionally, buildings of all ages, functions, and locations across New York State are vulnerable to the impacts of climate change. Each of the State's regions will experience a range of these impacts, including more severe storms, coastal and inland flooding, and increasing temperatures, all of which can affect building structures and systems, operations, and occupants.[1] Greenhouse gas mitigation strategies are essential to reducing these impacts, and are currently underway; however, given historic emission levels and their current trajectory, some degree of climate change is now not only inevitable, but is already occurring. Therefore, it is critical that design and construction teams account for the climate change that will occur during the useful life of new and majorly renovated buildings.

Resiliency and decarbonization strategies can be mutually supportive. Decarbonization strategies such as electrification, energy efficiency, demand flexibility, and onsite energy generation and storage support building resiliency. Low impact development (LID) can further enhance the resilience of the building by reducing the impacts of heavy precipitation events and extreme heat. In the design process, strategies to increase resilience should be considered alongside those primarily aimed to increase energy efficiency and reduce carbon emissions. In combination, such strategies ensure an integrated decarbonization approach over the building's full or remaining useful life. A climate resilient building may also require less maintenance over its useful life, reducing its overall carbon footprint and resource intensity.

The State has released several laws, executive orders, and roadmaps that outline the State's commitment to reducing greenhouse gases and adapting to climate change at the building scale. This Guide seeks to unify those directives and set out a clear path for State Affected Entities to follow to meet the goals of Executive Order 22 (E.O. #22), the Climate Action Council's Scoping Plan commitments, and the Senate Bill S4006C (Education, Labor and Family Assistance Bill).

This interim guidance document is the first step in a future series of guidance documents. It outlines recommended strategies that State agency capital project teams should incorporate into the design of new State buildings, and major renovations as relevant, to align with the following key priorities:

- Increase energy efficiency
- Zero emissions
- Design for climate resilience

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1 NYS Climate Impacts Assessment, Buildings Chapter, Key Finding 1 (2024) https://nysclimateimpacts.org/wp-content/uploads/2024/02/Assessment-ch4-buildings-01-31-24.pdf

In some instances, agencies may have developed their own internal guidance that covers these topics. Where overlap exists, the more stringent standard should be used. Please reach out to sustainability@ogs.ny.gov with additional questions.

1.1 Applicability

This interim guidance applies to all new construction buildings owned/operated by State Affected Entities. "New construction" refers to:

- The construction of a new building that is occupied during all four seasons and is 5,000 ft^2 or larger.

Project teams for existing buildings undergoing major renovations should seek to incorporate the guidance to extent possible. "Major renovations" include any project in which:

- The renovated area includes 10,000 ft^2 or more, and/or
- The cost of renovation is expected to exceed $2 million.

This Guide does not explicitly refer to building typologies such as historic buildings, laboratories and other non-standard uses. Future iterations of this Guide will include more detailed information for such other uses. In the interim, this Guide should be incorporated into design to the extent possible, including for renovations of historical buildings, and supplemented with additional guidance relevant to these unique cases such as the Whole Building Design Guide "Sustainable Historic Preservation" and the Environmental Protection Agency's page on "Smart Growth and Preservation of Existing and Historic Buildings."

Finally, there are many existing third-party certification programs and standards that meet many of the above requirements. Should an Affected Entity pursue one of the third-party certification programs below, it would be the equivalent of pursing the minimum requirements of this Guide and the third-party recommendations should be followed:

- LEED v5 (level of achievement of Silver or higher)
- Green Globes
- International Green Construction Code (IgCC)
- ENVISION v3 (level of achievement of Silver or higher)

1.2 Methodology

The New York State Office of General Services (OGS) developed this interim guidance with support from New York State Energy Research and Development (NYSERDA) and Arup between Q4 2023 and Q1 2024. The development process included stakeholder meetings with representatives from several New York State Affected Entities, a market analysis of best practice guidance across jurisdictions, and an analysis of State regulations and priorities.

OGS, NYSERDA, and the New York Power Authority (NYPA) in partnership with other state entities will be developing further guidance that will include more detail on specific sections, particularly the "Design for Climate Resilience" section. This further guidance will be applicable to existing buildings and infrastructure.

2 Regulatory Drivers

Through the Governor's nation-leading Climate Leadership and Community Protection Act 2019 (Climate Act), New York State committed to reduce greenhouse gas emissions, increase energy efficiency, and increase renewable energy use, and set out ambitious targets in each. The Act sets the goals to reduce economywide emissions to 40% below 1990 levels by 2030 and then to 85% below 1990 levels by 2050. It also sets out a target to source 100% zero-emission electricity by 2040. As emissions from buildings (space and water heating, and electricity use) account for over 30% of economywide emissions, buildings are a critical component of reducing our statewide emissions.[2]

In September 2022, the Governor issued Executive Order 22: Leading by Example (E.O. #22) to accelerate efforts to make State operations more sustainable. This Executive Order includes a wide range of sustainability topics for State Affected Entities[3] to consider. For new buildings and major renovations, it includes directives related to energy efficiency, avoiding fossil fuels, low impact development, and improving the State's preparedness for climate change related risks. See the E.O. #22 section below for the specific sections covered in this Guide.

In December 2022, the Scoping Plan was published by the Climate Action Council, as required by the Climate Act. The Scoping Plan includes a comprehensive roadmap of initiatives to link decarbonization, renewable energy, and climate adaptation efforts with a just transition and economic development. A key objective of this scoping plan is "Leading-by-Example in State Projects" by implementing highly efficient, zero-emission, and climate resilient construction.

Chapter 12 of the Scoping Plan, the Buildings chapter, emphasizes updating regulations in 2025 to adopt a "highly efficient State Energy Code" for new construction, "building resilience features into State codes," and "prohibit[ing] building systems or equipment used for the combustion of fossil fuels in new construction." It also points out that "State entities will lead by example … pursuant to Executive Order 22."

In April 2024, the Senate passed Senate Bill S4006C/A3006C (Education, Labor and Family Assistance Bill) enacting into law key amendments to the energy law (Subdivision 6 of section 11-104) and future New York State Energy Conservation Construction Code updates. This law, which applies to new buildings, prohibits the installation of fossil fuel equipment and building systems starting January 1, 2026, for new buildings up to 7 stories tall (except for commercial and industrial buildings larger than 100,000 square feet). In 2029, the applicability of these restrictions will expand to include all new buildings – with exemptions.[4]

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2 NYS DEC State GHG Emissions Inventory (2023) https://dec.ny.gov/sites/default/files/2023-12/summaryreportnysghgemissionsreport2023.pdf

3 New York State Affected Entities refers to "any agency or department over which the Governor has executive authority...as well as public authorities" "except the Port Authority of New York and New Jersey. This shall include the State University of New York and the City University of New York." Exhibit A of E.O. #22 contains the full list of 75 Affected Entities.

4 Exemptions include: manufacturing facilities, hospitals, crematoriums, wastewater treatment facilities, commercial food establishments, laundromats, and emergency backup power. Also new agricultural buildings, manufactured homes, car washes, and other medical facilities beyond hospitals, and critical

2.1 Executive Order 22

E.O. #22 contains directives that address a wide variety of topics related to decarbonization and sustainability. Full compliance with E.O. #22 is achieved at the scale of each Affected Entity and requires action to be taken throughout all phases of building planning, design, construction, and operation. Therefore, adherence to this document does not represent comprehensive compliance with E.O. #22.

For existing guidance that relates to other elements of E.O. #22, refer to the GreenNY E.O. #22 Guidance and Templates page. For access to this SharePoint site, please contact your agency's Sustainability Coordinator or email the GreenNY Council at GreenNY@dec.ny.gov

2.1.1 Sections of E.O. #22 Addressed by this Guide

Adherence to this Guide will ensure new and majorly renovated buildings are compliant with the following subsections of E.O. #22:

VII. Reducing Greenhouse Gas Emissions

> *B. "To the fullest extent feasible, beginning January 1, 2024, all new construction submitted for permitting by Affected Entities shall avoid infrastructure, building systems or equipment that can be used for the combustion of fossil fuels, excluding the necessary use for backup emergency generation and process loads, provided that Affected Entities shall avoid the use of backup emergency diesel generators where practicable. This shall not affect the continued operation and maintenance of State or Affected Entity owned or operated electric generating facilities."*

XI. Low Impact Development

> *C. Climate Risk Incorporation*
>
> > *1. "New infrastructure and building projects shall be designed and built to account for the climate changes that may occur over their lifespans. This includes incorporating climate projections and adaptation strategies in upfront design and expected operations and management. Preservation of open space shall be considered as a strategy for climate risk mitigation in new and existing construction.*
> >
> > *2. The Council will provide guidance on incorporating climate projections and climate risk concepts to Affected Entities."*

2.1.2 Relevance to Other E.O. #22 Requirements:

The Guide is designed to be complementary to other E.O.#22 requirements and seeks to align building-scale recommendations appropriately. However, in the event that characteristics of a specific site are such that multiple sets of guidance could apply, the more stringent requirement should be used.

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infrastructure including emergency management facilities. IT also exempts fuel cell systems. This all-electrical new construction will be implemented and enforced under the state energy code, which will be updated in 2025.

BuildSmart 2025: E.O. #22 directs Affected Entities to achieve energy savings targets set by the BuildSmart program, pursuant to VII.C.1 “Affected Entities shall achieve 11 trillion BTUs of energy savings at their facilities by 2025 as outlined in the BuildSmart 2025 program.” This document has been designed to be complementary to the BuildSmart 2025 guidance. As such, following the design strategies, particularly the enhanced strategies, in the guidance will support greater energy savings that could be counted towards BuildSmart 2025 energy savings.

Low Impact Development (LID): E.O. #22 section XI.A directs Affected Entities to “evaluate, and to the maximum extent practicable, incorporate green infrastructure concepts to reduce all stormwater runoff and improve water quality in new construction or redevelopment projects submitted for permitting by Affected Entities regardless of disturbance threshold.” This document is focused on building-level strategies, and therefore limits the scope of its recommendations to LID strategies at the building scale. However, it is understood that some projects may include both building and site-level improvements in the scope of the project, and therefore some sections of this Guide include LID strategies for project managers to consider. Additional detail on site-level LID may be included in future versions of this Guide. Project managers are also encouraged to consult and utilize the DEC Stormwater Design Manual (2022) by incorporating the future climate projections found in Appendix C when designing site-scale stormwater systems, as well as other resources such as the Environmental Protection Agency (EPA) LID resource page.[5]

Embodied Carbon in Construction Materials: E.O. #22 section VII.D directs State Affected Entities to calculate and reduce embodied carbon in new construction and major renovation projects. Embodied Carbon, the emissions related to the extraction of materials, transport, and manufacturing of a product, is a critical part of designing and delivering a Net Zero Building. The GreenNY Council has issued detailed guidance for State Affected Entities on Embodied Carbon, and agencies and authorities should refer to the existing E.O. #22 Embodied Carbon Guidance for compliance with this section of the Order.

100% Renewable Energy: E.O. #22 section VII.A directs State Affected Entities to source 100% of the electricity used for operations (except that used for electricity generation) from Clean Energy Standard (CES) sources by 2030. In section VII.F, it also directs State Affected Entities to evaluate the inclusion of Distributed Energy Resources, including solar photovoltaic installations, and energy storage. The GreenNY Council 100% Renewable Energy Policy Guidance can be found here (only accessible by State Affected Entities). For more information on Distributed Energy Resources, see NYSERDA’s Renewables/Distributed Energy Resources list.

[5] EPA Nonpoint Source: Urban Areas (2023) https://www.epa.gov/nps/nonpoint-source-urban-areas

Electric Vehicles: E.O. #22 section VII.E directs State Affected Entities to convert their vehicle fleets to Zero Emission Vehicles, converting light duty non-emergency vehicle fleets by 2035 and medium- and heavy-duty vehicle fleets by 2040. While E.O. #22 does not specifically address vehicle charging, State Affected Entities should consider the infrastructure needed to support the current and future electrification of their fleets in plans for new buildings that will include parking facilities.

Additionally, Section 19-A of State Finance Law requires new construction projects that include parking facilities to install electrical infrastructure to support electric vehicle charging stations with a minimum capacity of 40A/208V. Facilities with 50-200 spaces must plan for a minimum of 10% of available parking spaces to contain future EV charging, and facilities with more than 200 spaces must plan for a minimum of 20%.[6]

[6] Exemptions to this law state that projects may be exempt if the commissioning agency, together with NYSERDA and DPS deem that “complying with such provisions would not be in the public interest or would result in unnecessary hardship. In making this determination, the state entity or other governmental unit may consider the availability of sufficient electrical transmission or distribution infrastructure or capacity.”

3 Cost Considerations

Taking a life cycle approach is critical to fully understand and account for the costs and benefits of sustainable and resilient design.

This includes accounting for the full spectrum of costs, beyond just upfront capital cost, over the course of the building's useful life: such as the social cost of carbon, the avoided cost of damages, operational cost savings, and energy reduction. Teams should also pursue an integrated design process, which can reduce costs significantly by streamlining decision-making early in the design process. Consider the following elements:

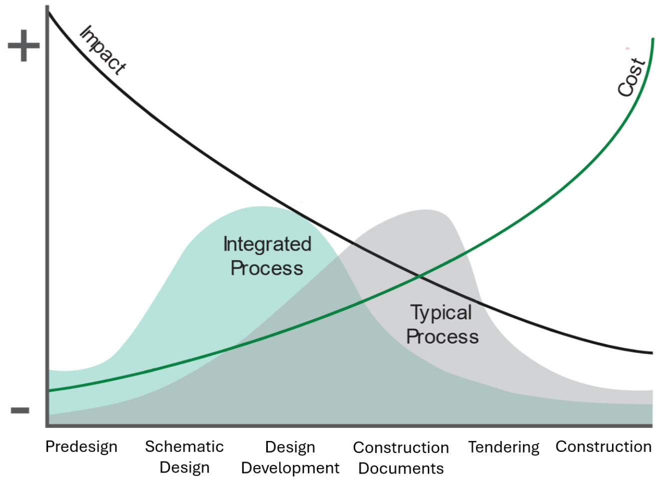
3.1 Operational Savings / Payback Period

Design strategies that reduce a building's energy consumption provide operational savings over time. When evaluating energy efficiency measures, consider the payback period alongside any incremental upfront cost. NYSERDA's Commercial Cost Analysis Report, found in their NYStretch Adoption Resources, provides information on payback periods modelled for compliance with NYStretch. The BuildSmart 2025 program requirement is to implement any energy efficiency measure with a 10-year payback period or less.

3.2 Integrated Design

Projects can offset the cost of high-performance design strategies and associated soft costs[7] by following an integrated design process.

Figure 1. Integrated Design Approach



In an integrated process, key stakeholders work collaboratively to make important design decisions earlier in the process, which can have many benefits including: 1) opportunities to identify cost-saving solutions, such as offsetting the potentially higher cost of some energy efficiency strategies by reducing the size of, or eliminating, heating/cooling equipment or systems; 2) a proactive approach

7 Soft costs are defined as money that is spent on labor services, transport, etc. rather than on physical equipment.

to identifying and solving problems before they occur, saving time and money; and 3) better decision-making by taking into account all the factors, risks, costs, and benefits simultaneously and collaboratively.

Facilities staff should be involved as early as possible (ideally at the pre-design/planning stage) and involved throughout to ensure operability considerations are integrated from the project inception.

NYSERDA's Carbon Neutral Buildings Roadmap estimates that design teams can reduce costs by up to 50% by following an integrated design process.

3.3 Avoided Damage in an Extreme Event

Upfront investment in strategies to increase weatherization and resilience can offset major expenses that might otherwise be necessary for repair and disruption mitigation in an extreme weather event. The Natural Hazard Mitigation Saves report published by the National Institute of Building Science in 2019 estimates that designing buildings to above-code measures of hazard mitigation could save $4 for every $1 spent on disaster recovery.

3.4 Social Cost of Carbon

The Social Cost of Carbon captures the estimated value of future damages due to climate change in areas including agricultural productivity, human health, property, and ecosystem services. E.O. #22 section VII.G directs State Affected Entities to use the Value of Carbon Guidance published by DEC "to aid in their decision making on greenhouse gas emissions reductions" where appropriate.

4 Nationwide Precedents

As part of the development process of this interim guidance, OGS conducted a study to identify best practices of similar existing guidance in other states and territories, as well as at the federal level. This study focused specifically on energy efficiency, decarbonization and climate adaptation guidelines for government projects.

The review of best practices showed that:

- States leading in energy efficiency, decarbonization, and climate adaptation policy and guidance require state agencies' buildings to exceed energy performance compared to the baseline energy code requirements. Some examples include:
    - The Massachusetts LEED Plus 2.0 Standard requires proposed buildings for use by state agencies to reduce Energy Use Intensity by at least 20% compared to an equivalent building that meets the Massachusetts Energy Code.
    - The State of Vermont Department of Buildings and General Services Design Guidelines require all new construction and major renovations to achieve 10% energy savings over a minimally code compliant building, and to strive to achieve Net Zero Ready certification when possible (20% energy savings compared to code).
    - Connecticut’s Capital Projects High Performance Buildings Guidelines require state buildings to meet a base minimum energy performance 21% better than current code or ASHRAE 90.1-2004.
- It is also common practice for state governments to require state buildings to meet the standards of some third-party building certification or standard.
    - States including Vermont, California, Massachusetts, Washington, Maryland, and Rhode Island each require projects to meet some level of LEED-certification, or to choose between LEED, Green Globes, and the International Green Construction Code.
    - Minnesota’s B3 program has its own detailed design requirements for public buildings, but aligns with common third-party standards where possible to create easier pathways for dual certification.
    - Vermont, Connecticut, Minnesota, and Massachusetts all reference the use of ENERGY STAR®-rated equipment, where applicable.
- The “Gold Standard” for reducing carbon emissions across state agencies includes robust benchmarking and transparent tracking and reporting of progress.
    - The Minnesota state government tracks progress achieved against goals related to electrifying their vehicle fleets, reducing energy and water consumption, reducing waste, improving the sustainability of procurement, and reducing greenhouse gas emissions on sustainability.mn.gov. They also publish Agency Score Cards, which track the progress of individual agencies toward their goals.

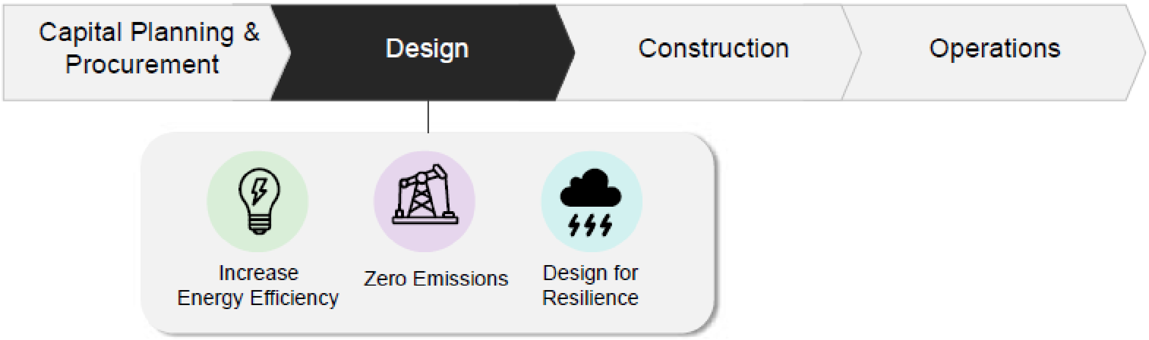
5 Design Recommendations

5.1 Overview

This Guide gives design-phase direction on three priorities for new construction or, where applicable, a major renovation building project:

- Increase energy efficiency
- Zero emissions
- Design for climate resilience

Figure 2. Recommended Use of the Guide in a Typical Project Lifecycle



The Guide is designed to be used in the design phase and are most effective when incorporated from the project outset (from predesign or schematic design). Agencies are also encouraged to consult the Guide when capital planning and budgeting,

The Guide includes a section for each priority. Each section includes:

- **Regulatory Drivers:** A summary of key laws and regulations applicable to the priority, including the relevant regulations in E.O. #22. *Note: This does not represent a comprehensive list of all laws and regulations governing the design and construction of a new building.*
- **Minimum Recommended Design Strategies:** These strategies represent recommendations for the minimum standards for state agency buildings. They were designed to meet or exceed the relevant requirements in E.O. #22 and other relevant regulations. Project teams should seek to include all applicable recommendations from this category.
- **Enhanced Design Strategies:** These strategies will help a project achieve high performance but may require more analysis or upfront investment. Project teams are encouraged to evaluate the feasibility of these strategies for their project. The Enhanced Design strategies should be considered in addition to the Minimum Recommended Design Strategies, except in cases where the Enhanced strategy supersedes the relevant Minimum Recommended strategy.

Links to additional guidance and resources are provided throughout this document where available, along with notes on the potential cost impact of strategies as documented in available literature. Third-party rating systems, such as LEED, are referenced for particularly relevant individual credits. Agencies are not required to pursue full certification.

5.2 Accompanying Strategy List

This interim guidance includes an accompanying strategy list in spreadsheet form. The accompanying resource presents the same recommended strategies as this document, organized by building system rather than goal. State Affected Entities' project teams are encouraged to use whichever form of the guidance they find most helpful.

6 Increase Energy Efficiency

6.1 Overview

Optimizing for energy efficiency first is a critical step to achieving equitable and cost-effective decarbonization. Implementing energy efficiency measures that reduce the amount of heating and cooling needed in a building can reduce the size and cost of building systems, as well as utility costs, while improving resilience to temperature swings and extreme events. This Guide includes minimum standards for energy efficiency strategies such as high-performance envelope design, reduced lighting and plug loads, and high-efficiency equipment and building systems. Though this document focuses on design strategies, training for facilities staff is recommended to ensure staff are equipped to operate and commission energy efficient equipment.

6.2 Regulatory Drivers

New State buildings should be designed to be as energy efficient as possible to support the overall decarbonization goals of E.O. #22. As stated in the Climate Action Council's New York State Scoping Plan, New York State is expected to adopt a highly efficient State Energy Code for new construction by 2025.

New York State Energy Conservation Construction Code 2020 (NYSECC 2020) regulates the minimum energy conservation requirements for new buildings. As of the publishing on this document, it is the most current state energy code.

The NYStretch Energy Code - 2020 is a supplement to NYSECC 2020 developed by NYSERDA. It provides a cost-effective and regionally appropriate option for improved energy performance compared to the baseline code requirements, designed to align to updates in stringency expected in the next iteration of the New York State Energy Conservation Construction Code. For more information, see NYSERDA's NYStretch Adoption Resources.

For a simple comparison of the base code versus the NYStretch Energy Code, please refer to Appendix B.

Note that the next iteration of the New York State Energy Conservation Construction Code, anticipated in 2025, is expected to increase the stringency of energy efficiency requirements for all buildings. This document should not be interpreted to supersede any more stringent requirements enacted by future updates to NYSECC or any other codes.

6.3 Increase Energy Efficiency: Minimum Recommended Design Strategies

6.3.1 Overall Building Energy Performance

i. Comply with NYStretch in addition to the baseline New York State Energy Conservation Construction Code (NYSECC 2020) or most current state energy code.
The NYStretch Energy Code was designed to improve average energy performance

by 10-12% compared to NYSECC 2020, although specific performance improvements will vary based on building type and compliance path.

Cost Note: NYSERDA completed a Commercial Cost Analysis Report, found in their NYStretch Adoption Resources, which indicates that use of NYStretch provides a 7.1% reduction in energy cost, and an incremental first cost of $1.14/ft2, when compared to baseline compliance with NYSECC 2020. The average simple payback period across all building types was found to be 10.5 years. For a large office, the simple payback period was found to be 3-5 years.

6.3.2 Building Envelope

i. Comply with relevant NYStretch requirements in addition to the baseline New York State Energy Conservation Construction Code (NYSECC 2020) or most current state energy code.

Cost Note: Investments in an energy efficient envelope reduce energy costs over time. They can also reduce the size and cost of needed heating and cooling equipment by reducing the peak load. The NYSERDA Commercial Cost Analysis Report, found in their NYStretch Adoption Resources, indicates that, in some building types including Large Offices, the cost saved from reduced equipment can be greater than the incremental cost of a NYStretch-compliant envelope. Other energy efficiency improvements such as lighting power density reduction also contribute to the reduction of the cooling load.

6.3.3 HVAC, Domestic Hot Water, and Appliances

i. Comply with relevant NYStretch requirements, including but not limited to section C407, in addition to the baseline New York State Energy Conservation Construction Code (NYSECC 2020) or most current state energy code.
ii. Select ENERGY STAR® certified products wherever applicable. Or where ENERGY STAR® is not an option, refer to New York State's Current Appliance and Equipment Efficiency Standards.

Cost Note: The ENERGY STAR® website notes that "by choosing ENERGY STAR, a typical household can save about $450 on their energy bills each year."

6.4 Increase Energy Efficiency: Enhanced Design Strategies

6.4.1 Overall Building Performance

i. Design the building to meet one of the following definitions (in order of priority):

- **Zero Emissions Building:** The U.S. Department of Energy released a draft definition of a zero emissions building in 2023. The minimum criteria to meet the definition include a building that is: "Highly energy efficient, free of on-site emissions from energy use, and powered solely from clean energy."

  For more information, see the National Definition of a Zero Emissions Building: Part 1.

- **Zero Energy Building (commonly referred to as Net Zero Building):** Defined by the U.S. Department of Energy as "an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy."

  For more information, see A Common Definition for Zero Energy Buildings.

ii. If achieving the above is not possible, aim to reduce energy consumption by at least 20% compared to a NYSECC 2020 baseline compliant building.

6.4.2 Building Envelope

i. Follow the requirements of both NYStretch C406.6 Enhanced Envelope Performance, which requires an additional 15% improvement in the envelope's thermal performance, AND C406.7 Reduced Air Infiltration, which requires a maximum air leakage rate of 0.25 cfm/ft2 as verified by whole building pressurization testing.

ii. Design the building envelope to meet Passive House standards (aligned to Phius CORE or Phius ZERO). *Note: Envelope improvements support Energy Efficiency, Zero Emission, and Climate Resilience goals. Therefore, this section appears in all three parts of this Guide.*

6.4.3 Lighting and Plug Loads

i. Comply with NYStretch C406.3 Reduced Lighting Power and C406.4 Enhanced Digital Lighting Controls.

ii. Incorporate natural lighting to reduce the use of electric lighting and promote occupant well-being, such as through strategic window placement, solar tubes, etc.

iii. Consider advanced control strategies including the following:

- Incorporate occupancy-sensing plug strips to automatically turn off equipment and emergency lighting sources that operate during normal business hours, when not in use. All plug load management strategies should be accompanied by outreach and education to ensure building occupants are familiar with the intended use and would not apply to life-safety and security equipment.

- Implement a Building Management System (BMS) or an Energy Management Information System (EMIS) that includes control of all major plug loads and appliances. The BMS/EMIS should respond to sensors within the building and external, grid-level information (current electricity prices or marginal carbon emissions) to optimize building performance.

  See NYSERDA's Carbon Neutral Buildings Roadmap for more information.

6.4.4 HVAC, Domestic Hot Water, and Appliances

i. Consider incorporating greywater systems to reduce overall water use.

ii. Incorporate induction cooking where feasible.

iii. Incorporate enhanced control strategies using BACnet infrastructure or equivalent.

iv. Include measurement devices to monitor building energy and electrical use, for buildings of all sizes. This recommendation aligns with the following NYStretch requirements, which have exceptions for smaller buildings.

- C405.12 Whole Building Energy Monitoring requires the installation of measurement devices to individually monitor energy use of natural gas, fuel oil, propane, steam, chilled water, and hot water supplied by a utility, energy provider, or plant that is not within the building.
- C405.13 Whole Building Electrical Monitoring requires the installation of measurement devices capable of recording and reporting electrical energy use.

7 Zero Emissions

7.1 Overview

Implementing all-electric building systems and equipment in new construction projects, and major renovation as applicable, is key to achieving the State's climate and sustainability goals. This Guide includes minimum standards for building electrification and complementary electric vehicle charging infrastructure. When considering electrification options for larger buildings, grid friendly, refrigerant friendly, and low operating cost options such as geothermal should be strongly considered. Also, the cost of grid connection, local grid capacity constraints should be evaluated early in the pre-schematic design.

7.2 Regulatory Drivers

Section VII.B of E.O. #22 directs State Affected Entities to lead by example in avoiding infrastructure, building systems or equipment that can be used for the combustion of fossil fuels "to the fullest extent feasible," beginning in January 2024 for all new construction. An exception is provided for necessary use of fossil fuels for backup emergency generation and process loads. These exceptions for back-up emergency power apply to buildings used for emergency management, including hospitals. However, the use of backup emergency diesel generators should be avoided when practicable.

The State's 2023-2024 Budget includes legislation (Senate Bill S4006C/Assembly Bill A3006C) that prohibits the installation of fossil fuel equipment and building systems in:

- Any new building no more than 7 stories high starting in 2026, except new commercial or industrial buildings greater than 100,000 ft2 in conditioned floor area
- All new buildings starting in 2029[8]

This document is intended to bridge the gap between requirements for State buildings and anticipated code updates. When code updates are in effect, these requirements would become the baseline and this Guide will be updated accordingly.[9]

[8] This legislation applies to new construction only and excludes emergency back-up and standby power requirements, as well as agricultural facilities. Manufacturing facilities, commercial food establishments, laboratories, car washes, laundromats, hospitals and medical facilities, critical infrastructure, fuel cell systems, and crematoriums must limit the use of fossil fuels to the system and area of the building where full electrification is infeasible and design systems to be electrification ready. For all exceptions, see S4006C (https://www.nysenate.gov/legislation/bills/2023/S4006/amendment/C).

[9] For more, see Urban Green Council's "Decoding New York State's all-electric new buildings law."

7.3 Zero Emissions: Minimum Recommended Design Strategies

7.3.1 HVAC, Domestic Hot Water, and Appliances

i. Implement all-electric, high efficiency or ENERGY STAR® certified equipment and building systems.

- **All-Electric Heating, Ventilation & Air Conditioning:** Select high-efficiency, all-electric systems for building heating, cooling, and ventilation. Use heat pumps wherever possible. Consider high-lift heat pumps for appropriate projects intending to operate at cold temperatures.
- **All-Electric Domestic Hot Water:** All projects should utilize high-efficiency all-electric domestic hot water systems and utilize low-flow fixtures to minimize water use. Use heat pumps or hybrid heat pump water heaters wherever possible.
- **All-Electric Appliances:** All ranges, cooktops, and clothes dryers included in the project should be all-electric wherever possible. Buildings that include laundry should use heat pump clothes dryers wherever possible.

Cost Note: NYSERDA's Carbon Neutral Buildings Roadmap includes the following estimates for the incremental cost of electrification compared to a gas baseline building: For a new construction 12-Story, 500,000 ft2 classroom building in upstate NY: $1.90/ft2; for a 7-story multifamily building in downstate: $2,000 per unit. Data from NYSERDA's Buildings of Excellence Design Competition demonstrate that new buildings that are highly efficient and all-electric have an average incremental cost of less than 7%, and less than 2% after identifying available tax credits and incentives.

7.3.2 Distributed Energy Resources & Energy Storage

Note: Distributed Energy Resources support Zero Emission and Climate Resilience goals. Therefore, this section appears in both parts of this Guide.

i. Conduct a Solar Feasibility Study for the project, including the performance of a cost-benefit analysis and calculation of the estimated payback period for a solar installation with energy storage. See the EPA resource on Conducting Site and Economic Renewable Energy Project Feasibility Assessments for more information. If an agency is conducting solar master planning as a part of the E.O. #22 100% renewables commitment, this can be used in lieu of this recommendation.

ii. For new construction, design the building to be at least "Solar Ready" by complying with NYStretch C405.11 Solar Ready Zone requirements. Broadly, this entails ensuring open roof space is maximized (for example, consolidating and locating HVAC/rooftop equipment to the north and edges of the roof), providing raceways/conduit paths from the roof to electric utility room(s), orienting roof planes to the south/east/west to the extent possible, and designing for appropriate structural loads. For major renovations, the building should comply with this section where possible, especially if a project is moving HVAC/rooftop equipment or replacing the roof. Project managers should ensure solar considerations are consistent with and contribute to the agency's goals of 100%

renewable energy, especially when considering a major renovation project. If a future solar installation will be located on the roof, ensure that the roofing warranty allows for future installation.

iii. Evaluate the feasibility of on-site energy storage to serve the building's critical loads. Refer to the Federal Department of Energy's Better Buildings Solution Center's On-Site Energy Storage Decision Guide for more information.

7.3.3 Site Considerations - Electric Vehicle Charging

i. Estimate the number of agency fleet vehicles expected at the location in 2030, based on each Affected Entity's Zero Emissions Vehicle (ZEV) Conversion Plans. Install electric panel capacity and conduit for the future installation of enough EV charging outlets to support those vehicles. Consider including future vehicle-to-grid capabilities for added resilience benefits.

7.4 Zero Emissions: Enhanced Design Strategies

7.4.1 Building Envelope

i. Design the building envelope to meet Passive House standards (aligned to Phius CORE or Phius ZERO). *Note: Envelope improvements support Energy Efficiency, Zero Emission, and Climate Resilience goals. Therefore, this section appears in all three parts of this Guide.*

7.4.2 HVAC, Domestic Hot Water, and Appliances

i. Select a refrigerant with a low Social Cost of Carbon as defined by the Department of Environmental Conservation's (DEC) Value of Carbon Guidance.

ii. Consider geothermal (ground source) heat pumps particularly for large buildings. NYSERDA's Large Scale Thermal program has additional detail and site level considerations for appropriate buildings/campuses.

7.4.3 Distributed Energy Resources & Energy Storage

i. Install Distributed Energy Resources (such as photovoltaics) and battery storage with enough capacity to power critical loads (as determined by the Affected Entity) in the event of a power loss. Energy storage capacity should be sufficient to supply the PV system output for four full hours (i.e., four kWh battery capacity for each kW PV capacity).

Note: Distributed Energy Resources support Zero Emission and Climate Resilience goals. Therefore, this section appears in both parts of this Guide.

7.4.4 Site Considerations - Electric Vehicle Charging

i. Provide workplace charging for employee's personal vehicles. Refer to NYSERDA's ChargeNY Workplace Charging Guide and Workplace Electric Vehicle Charging Policies Guide.

ii. Provide publicly accessible charging. Refer to NYSERDA's Site Owners of Electric Vehicle Charging Stations on Commercial Properties – Best Practices Guide.

iii. Design for vehicle-to-grid capabilities for added resilience.

8 Design for Climate Resilience

8.1 Overview

The following flowchart outlines the key steps for considering climate change impacts throughout the design process. By 1) screening for climate hazards specific to the project site, 2) evaluating future risk exposures based on climate projections, and 3) implementing appropriate resilience design guidance, projects teams can create buildings that are better prepared to withstand the effects of climate change over their useful life. This iterative approach integrates resilience starting at the initial planning phases, resulting in a more sustainable and climate resilient built environment.

Figure 3. Flow Chart of Three Steps to Design for Climate Change

Note: Projects located in New York City (NYC) should use the guidance in the NYC Climate Resiliency Guidelines in lieu of the guidance in this section.

Current codes and standards that regulate the design of facilities incorporate historic weather data to determine how to design for today's conditions. These standards reference products such as Federal Emergency Management System (FEMA) maps or National Oceanic and Atmospheric Administration (NOAA) Atlas 14 to create baseline design requirements based on historic conditions. However, historic data does not accurately represent the projected severity and frequency of future storms, sea level rise, heat waves, and precipitation. This document aims to provide direction to go beyond current codes and standards to incorporate specific, forward-looking climate data to ensure State buildings are designed to operate over their full anticipated useful life.

8.1.1 Determining Useful Life

A resilient building for the purpose of this document is one built to withstand or rapidly recover from climate hazards, and to perform to its intended design standard throughout its useful life in a changing climate. To meet this goal, facilities should be designed to withstand climate conditions projected for the end of the building or component's useful life. Table 1 provides examples of how to select climate change projections for a variety of building project components. Buildings are anticipated to have a useful life of 60 to 100+ years depending on their function, therefore climate projections to at least the 2080s should be used to inform new construction design criteria.[10]

To determine the anticipated useful life of individual equipment components, reference manufacturer recommendations, industry standards or code recommendations. Professional judgement should be used to determine the appropriate useful life of building projects.

10 FEMA BCA Reference Guide, 2009, Appendix D https://www.fema.gov/sites/default/files/2020-04/fema_bca_reference-guide.pdf

This document recommends that the 90th percentile climate projections of the unweighted combination of the results from SSP2-4.5 and SSP5-8.5 scenarios (consistent with the NYS Climate Impacts Assessment) should be used to inform design (see Appendix C for climate projections by region). Future versions of this Guide may contemplate more specific direction based on project criticality.

Table 1: Useful Life Examples for a Variety of Building Project Components and Associated Recommended Climate Change Projections

Project component	Examples	Useful Life (Years)	Climate Change Projections Decade
Temporary or rapidly replaced components or finishings	• Interim and deployable flood protection measures • Temporary building structures	15-20	2040s
Facility improvements, components on a regular replacement cycle	• Electrical, HVAC, and mechanical components • Most building retrofits (substantial improvements) • Concrete paving • Infrastructural mechanical components (e.g., compressors, lifts, pumps) • On-site energy equipment (e.g., fuel tanks, conduit, emergency generators) • Stormwater detention systems	20-30	2050s
Long-lived buildings	• Most buildings (ex. Public, office, residential)	40-70	2080s
Buildings that cannot be relocated	• Buildings supporting critical infrastructure • Monumental buildings	70+	2100s

8.2 Regulatory Drivers

Section XI.C.1/2 of E.O. #22 directs Affected Entities to account for climate change in new infrastructure and building projects, including the incorporation of climate projections and adaptation strategies throughout design as well as expected operations and management. E.O. #22 also directs State Affected Entities to evaluate opportunities to harden their infrastructure and mitigate the impacts of climate change, and to evaluate the inclusion of Distributed energy resources and energy storage to the maximum extent practicable.

For state projects building or considering building within floodplains, project managers are expected to consult the 6 NYCRR Part 502 – Floodplain Management Criteria for State Projects prior to using the recommendations in this document. This required standard discourages siting of state projects within special flood hazard areas. Additionally, consistent with DEC Flood Risk Management Guidance, it is recommended that, to the extent feasible, development is discouraged in currently mapped floodplains (designated in FEMA flood maps) as well as in marsh-migration pathways and other areas likely to be flood-prone in the future, as defined by the highest of the applicable general flood risk management guideline elevations. This document should be used once siting analysis is complete if avoiding development in currently mapped floodplains is found to be infeasible (e.g., in the case of functionally dependent infrastructure or facilities such as culverts and bridges).

8.3 Design for Climate Resilience: Minimum Recommended Design Strategies

8.3.1 Identify and Reduce Climate Risk

i. Identify current and future climate hazard exposure to the building.

Project managers should use the resources in Table 2 to understand a building's high-level climate hazard exposure, as well as those in Appendix C for informing design basis. A high-level screening for climate hazard exposure can be done using the project's address and publicly available mapping tools, predicted future conditions, and site-specific knowledge. Project managers should screen for hazard exposure on all projects, not just those located in current hazard areas (such as floodplains as identified by FEMA), to determine whether the building may be located in a projected future hazard area by the end of its useful life. After initial desktop screening, recommendations should be supplemented with direct field measurements during design (such as elevation for flood). Project managers should ask, for each climate hazard in Table 2:

1. Is this building currently exposed to this climate hazard?
2. Is this building predicted to be exposed to this climate hazard by the end of its useful life?

If the answer is yes to either of these questions, project managers should proceed to the next section to identify and implement strategies to reduce risk.

Table 2: High-Level Future Climate Hazard Exposure Screening Resources (Non-Comprehensive)

Climate Hazard	Resource Name	Description	Additional Instructions for Use	Resource Link
Flooding Coastal & Riverine	NYS Flood Information Decision Support System	Visualization of various flooding scenarios and future sea level rise in communities throughout New York State (except NYC).	Using the projections in Appendix C, project managers should identify the estimated sea level rise (SLR) corresponding to the building or component's useful life. Then using the Flood Information Support System, type in the project's address. Add the layer with the closest SLR value + the 100 yr. storm.	https://sedac.ciesin.columbia.edu/mapping/nysfidss/?page=NYS-FIDSS&views=About
	NYS Base Level Engineering (certain counties)	This map shows the 1% Annual Chance and 0.2% Annual Chance Flood Hazards as well as cross sections with estimated Base Flood Elevations (BFEs) products of Base Level Engineering (BLE) in Region 2. These assessments use semi-automated modeling to produce credible engineering analysis for thousands of miles of streams.	If the project is in St. Lawrence, Franklin, Wyoming, Chautauqua, Cattaraugus, or Allegany counties, type the project address into this this map to establish the BFE, and then add the future climate projections associated with the building or component's useful life found in Appendix C.	https://region2-fema.opendata.arcgis.com/apps/d8dcae7f4b7a403eb866f0004c7b1199/explore
	NYC Flood Hazard Mapper	NYC Flood Hazard Mapper provides a comprehensive overview of the coastal flood hazards that threaten the city today, as well as how these hazards are likely to increase in the future with climate change.	If the project is in NYC, use this mapper to view coastal storm and tidal flood exposure to your project site. Type in the project address and add the "Base Flood Elevation (PFRIM 2015)" and "High Tide 2020s" layers to view present day exposure. To view future exposure, add the "Future Floodplain" and "High Tide" layers that correspond to the building or component's useful life.	https://www.nyc.gov/site/planning/data-maps/flood-hazard-mapper.page

Table 2 continued

Climate Hazard	Resource Name	Description	Additional Instructions for Use	Resource Link
Flooding – Stormwater	NYC Stormwater Flood Maps	The maps show a range of rainfall and sea level rise scenarios to show changing stormwater flood patterns over time.	If the project is in NYC, use this mapper to view stormwater flood exposure to your project site. Type in the project address to the “Moderate Flood with Current Sea Levels” map to view present day exposure. To view future exposure in an extreme stormwater event, depending on the useful life, type the project address into the “Extreme Flood with 2050 Sea Level Rise” or “Extreme Flood with 2080 Sea Level Rise” layer. Consider a building “exposed” to stormwater flooding if the site, primary access roads, primary road frontage at the site, and/or immediately adjacent properties are shown to be exposed to stormwater flooding.	https://experience.arcgis.com/experience/6f4cc60710dc433585790cd2b4b5dd0e

Table 2 continued

Climate Hazard	Resource Name	Description	Additional Instructions for Use	Resource Link
Heat Vulnerability	NYS HVI (Heat Vulnerability Index)	The HVI was developed based on 13 environmental and socio-demographic heat vulnerability factors, including 1) language vulnerability; 2) socio-economic vulnerability; 3) environmental and urban vulnerability; and 4) elderly isolation and elderly vulnerability. The HVI is a statewide and county map to identify areas where there is a higher proportion of people that have heat vulnerability characteristics.	Identify the census tract where the project is located. Consider a building "exposed" to heat vulnerability if it is located in the top 3 high vulnerability categories.	https://www.health.ny.gov/environmental/weather/vulnerability_index/
	NYC HVI (Heat Vulnerability Index)	The NYC Heat Vulnerability Index (HVI) shows neighborhoods whose residents are more at risk for dying during and immediately following extreme heat. It uses a statistical model to summarize the most important social and environmental factors that contribute to neighborhood heat risk. The factors included in the HVI are surface temperature, green space, access to home air conditioning, and the percentage of residents who are low-income or non-Latinx Black.	If the project is in NYC, use this map. Enter the neighborhood where the project is located. Consider a building "exposed" to heat vulnerability if it is located in HVI 4 or 5 designated areas.	https://a816-dohbesp.nyc.gov/IndicatorPublic/data-features/hvi/
	DEC UHI map (Urban Heat Island)	*Forthcoming*	*Forthcoming*	*Forthcoming*

ii. Once climate hazard exposure is established, incorporate design strategies to mitigate this risk. Minimum recommended design strategies are listed in this document; however, this is not an exhaustive list. Risk mitigation design strategies will be specific to the project scope.

- Project managers should identify design parameters that should incorporate regional future climate projections at the outset of the project. Future projections should be based on the expected lifespan of the building or applicable system or equipment. See Appendix C for regional climate projections.
- The following resources are helpful for identifying additional appropriate mitigation strategies:
  - Climate Resilience Strategies for Buildings in New York State (2018) – Identifies 25 strategies by region, hazard, and building system that can help improve the resilience of buildings in NYS. Broadly applicable to all building types and to all audiences (owners and operators, policy makers and planners, architects, and engineers).
  - Enterprise Hazard Strategies Guide – Summary table of climate hazard mitigation strategies applicable to a variety of housing types, with qualitative cost information. Applicable to garden-style and low/mid-rise residential buildings.
  - NYS Hazard Mitigation Plan (2023) - Includes a "mitigation measures inventory" that lists a broad range of solutions to identified risks, sortable by hazard.
  - ULI Developing Resilience Toolkit (2023) - Guidance to support real estate owners, developers, and investors with an initial, interactive search and reference tool for learning about risk reduction options, thereby enabling development, design, and sustainability teams or other stakeholders to quickly understand design and operational strategies that mitigate risks caused by natural hazards, their potential effects on costs and maintenance, and the co-benefits these strategies can bring.

8.3.2 Building Structure and Design

i. **For buildings at risk of current and/or future coastal, pluvial, and/or fluvial flooding**, follow the NYS Flood Risk Management Guidance for Implementation of the Community Risk and Resiliency Act climate-informed science approach. This guidance outlines the process for identifying a climate-informed guideline elevation that considers future flood conditions that are predicted to occur over the useful life of the building. Specifically, project managers should consult Table 4 – "Summary of recommended NYS flood risk management guideline elevations for structures" to establish a guideline elevation for the building. The general guidance for all flood risk areas is:

Avoid construction in the horizontal area defined by the applicable guideline elevations is preferable, if possible.

- Choose a guideline elevation based on the most restrictive of the following:

- BFE+2ft (+3 ft for critical facilities)
- 0.2% (500-year) elevation
- Climate informed science approach (BFE+SLR or projected flows + freeboard)

This Guide recommends following the climate-informed science approach to establish the guideline elevation of the building using the projections in Appendix C corresponding to the useful life of the building or component. Once established, use the guideline elevation in place of the base flood elevation, and follow requirements in Part 502 – Floodplain Management Criteria for State Projects.

ii. **For buildings exposed to extreme heat,** design the building orientation to reduce extreme solar heat gain. Minimize east- and west-facing glazing and incorporate exterior shading in the form of overhangs, porches, canopies, pergolas, shutters, or screens. Refer to NYSERDA and University of Buffalo's Climate Resilience Strategies for Buildings in New York State for more information on specific systems and components.

8.3.3 Building Envelope

i. **For buildings exposed to extreme heat,** install operable windows provided the area is 20 feet (6 meters) inside of and 10 feet (3 meters) to either side of the operable part of the window to mitigate heat impacts in the event of a power outage. The areas of operable window must meet the requirements of ASHRAE 62.1–2007, paragraph 5.1, Natural Ventilation (with errata but without addenda).[11]

ii. **For buildings exposed to extreme heat and/or urban heat island (UHI) risk** (as per the forthcoming DEC UHI map), design a "cool roof" to lower the roof surface temperature, reduce heat islands, and reduce cooling load. Select a roofing material with high solar reflectance or low thermal emittance (and ideally both). For more information, see the US EPA Using Cool Roofs to Reduce Heat Islands resources.

8.3.4 HVAC, Domestic Hot Water, and Appliances

i. **For projects at risk of flooding,** elevate all critical equipment above the guideline elevation (see above). Floodproof any critical equipment that cannot be elevated.

ii. **All projects** should identify and design HVAC equipment with design conditions adjusted to account for projected peak temperature and cooling loads over the lifetime of the equipment, and/or design ductwork and other longer-life ancillary systems with sufficient capacity to handle potentially larger future HVAC equipment. Consider the future cooling needs resulting from more extreme heat events and more frequent heat waves. Use the projected Heating Degree Days and Cooling Degree Days corresponding to the project useful life found in Appendix C, or more specific modelling, if available, to estimate future heating and cooling loads.

iii. **All projects** should identify systems that should be connected to backup power to maintain building operations in the event of a power outage. This should include any systems required for life safety at a minimum.

[11] LEED EQ6.2 Credit "Thermal Comfort – Controllability" https://www.usgbc.org/credits/eq62

iv. **For buildings that house full-time occupants** (NYS Building Code occupancy classification R-2 and R-4), ensure occupant access to heating and cooling. Occupancy classes with non-full-time residents (NYS Building Code occupancy classifications R-1 and R-3) are strongly encouraged to provide occupant access to heating and cooling.

8.3.5 Distributed Energy Resources and Energy Storage

Note: Distributed Energy Resources support Zero Emission and Climate Resilience goals. Therefore, this section appears in both parts of this Guide.

i. Conduct a Solar Feasibility Study for the project, including the performance of a cost-benefit analysis and calculation of the estimated payback period for a solar installation with energy storage. See the EPA resource on Conducting Site and Economic Renewable Energy Project Feasibility Assessments for more information. If an agency is conducting solar master planning as a part of the E.O. #22 100% renewable energy commitment, this can be used in lieu of this recommendation.

ii. New construction should design the building to be at least “Solar Ready” by complying with NYStretch C405.11 Solar Ready Zone requirements. Broadly, this entails ensuring open roof space is maximized (for example, consolidating and locating HVAC/rooftop equipment to the north and edges of the roof), providing raceways/conduit paths from the roof to electric utility room(s), orienting roof planes to the south/east/west to the extent possible, and designing for appropriate structural load. For major renovations, the building should comply with this section where possible, especially if a project is moving HVAC/rooftop equipment or replacing the roof. Project managers should ensure solar considerations are consistent with and contribute to the agency’s goals of 100% renewable energy, especially when considering a major renovation project. If the future solar installation would be located on the roof, ensure that the roofing warranty allows for future installation.

iii. Evaluate the feasibility of onsite energy storage to serve the building’s critical loads. Refer to the Better Buildings Solution Center’s On-Site Energy Storage Decision Guide for more information.

8.3.6 Site Considerations

This scope of this document is on building-level strategies. However, some projects may include scope beyond the building footprint, such as site-scale improvements (ex. parking lot construction/remediation, site stormwater design features, plazas, etc.), and therefore can contribute to resiliency goals. If a project 1) includes site-scale improvements are included in the project scope, and 2) the project is exposed to stormwater flood risk as per Table 2, project managers should consult the Low Impact Development (LID)/green infrastructure practices below. This should not be considered comprehensive guidance on designing to LID principles. Additional detail may be included in future versions.

i. Follow the 2022 DEC Stormwater Design Manual (draft) procedure to design building stormwater systems using the design criteria in Table 3. Section 4.9 of the DEC Stormwater Design Manual allows for use of either the Northeast Regional Climate

Center (NRCC) or NOAA Atlas 14 datasets to generate rainfall distribution curves. Project managers should use the NRCC data using emission scenario RCP8.5 to generate intensity-duration-frequency curves for the necessary return intervals.

Note: For projects located in the Delaware River Basin (DRB), the Delaware River Basin Commission rainfall data should be used.

Table 3: Climate-Informed Stormwater Design Criteria

Title	Link	Recommended design criteria
Statewide: Intensity Duration Frequency Curves for New York State	https://ny-idf-projections.nrcc.cornell.edu/	High RCP 8.5 2040-2069 (or end of useful life)
DRB only: Projecting Extreme Precipitation in the Delaware River Basin	https://drbc-idf.rcc-acis.org/	High RCP 8.5 2050-2099 end of useful life)

ii. Incorporate green infrastructure strategies in the design of hardscapes, including parking lots and walkways to minimize stormwater runoff. Refer to the EPA Stormwater Best Management Practice sheets for a brief summary of best practices, and the latest version of the New York State Stormwater Management Design Manual (found in the Construction Stormwater Toolbox) for detailed guidance on the calculation and management of stormwater. Green infrastructure strategies include, but are not limited to:

- Disconnect rooftop runoff where possible.
- Prioritize vegetated green infrastructure practices over non-vegetated alternatives, including swales, rain gardens, stormwater planters, and green roofs.
- Use permeable pavement, including gravel, cobbles, wood mulch, brick, grass pavers, turf blocks, or natural stone. Evaluate the feasibility of incorporating additional storage below pavers in addition to bioretention and grassed swales to store and filter stormwater. Ensure maintenance considerations are included when selecting permeable pavement alternatives.

Cost Note: The EPA Stormwater Best Management Practice on Permeable Pavements *includes lifetime cost comparisons and savings between traditional, porous asphalt, and pervious concrete.*

iii. Other site considerations:

- Incorporate paving materials with high solar reflectance index.
- Consider integrating solar electrical generation and storage with existing or new car ports, which can provide shade in addition to clean, renewable, and resilient energy.
- Prioritize tree planting, particularly large canopy trees, and increase existing tree canopy.

8.4 Design for Climate Resilience: Enhanced Design Strategies

8.4.1 Building Envelope

i. Design the building envelope to meet Passive House standards (aligned to Phius CORE or Phius ZERO). *Note: Envelope improvements support Energy Efficiency, Zero Emission, and Climate Resilience goals. Therefore, this section appears in all three parts of this Guide.*

ii. If the site is in coastal areas or other areas where extreme wind is a risk, incorporate a rainscreen and windows that can withstand hurricane force winds and rain.

8.4.2 Distributed Energy Resources & Energy Storage

i. Install Distributed Energy Resources (such as photovoltaics) and battery storage with enough capacity to power critical loads in the event of a power loss. Energy storage capacity should be sufficient to supply the PV system output for four full hours (i.e., four kWh battery capacity for each kW PV capacity). *Note: Distributed Energy Resources support Zero Emission and Climate Resilience goals. Therefore, this section appears in both parts of this Guide.*

ii. Design on-site renewable energy generation systems with the capacity to disconnect from the grid and operate without a grid connection ("islanding").

8.4.3 Site Considerations

The scope of this document is on building-level strategies. However, some projects may include scope beyond the building footprint, such as site-scale improvements (ex. parking lot construction/remediation, site stormwater design features, plazas, etc), and therefore can contribute to resiliency goals. If a project 1) includes site-scale improvements are included in the project scope, and 2) the project is exposed to stormwater flood risk as per Table 2, project managers should consult the Low Impact Development (LID)/green infrastructure practices below. This should not be considered comprehensive guidance on designing to LID principles. Additional detail may be included in future versions.

i. Implement additional volume and peak rate control as needed to account for the increased sizing criteria described above. See the latest version of the New York State Stormwater Management Design Manual (found in the Construction Stormwater Toolbox) for more information on appropriate management practices, which may include the following:

- Rainwater harvesting systems
- Intensive or extensive green roofs

ii. In areas of high exposure to rainfall flooding, projects are encouraged to manage stormwater volume that may enter the site from beyond the site boundaries using cloudburst management techniques. This approach implements a combination of methods that absorb, store, and transfer stormwater using grey and green infrastructure to minimize flooding from sudden, heavy rainfall events. These projects are sized to manage larger volumes of water than a typical design storm and aim to reduce risk to stormwater flooding. For example, consider additional rainfall volume in the sizing of stormwater runoff techniques following the Chapter 4 Unified Sizing Criteria process in the 2022 New York State Stormwater Management Design Manual such as:

- Use peak discharge from the 25-year flood in place of the 10-year flood when determining the Overbank Flood Control Criteria.
- Use peak discharge from the 500-year flood in place of the 100-year flood when determining the Extreme Flood Control Criteria.

Appendix A. Summary of References

A.1 Regulations

NYS Executive Order 22
New York State Energy Conservation Construction Code 2020: Energy code
NYStretch Energy Code - 2020: Stretch energy code
NYStretch Adoption Resources
NYS Senate Bill S4006C/Assembly Bill A3006C: All-electric buildings
Section 19-A of State Finance Law: Electric vehicle charging
E.O. #22 Guidance and Templates page

A.2 Increase Energy Efficiency

US DOE A Common Definition for Zero Energy Buildings.
US DOE National Definition of a Zero Emissions Building: Part 1
LEED
Green Globes
International Green Construction Code (IgCC)
NYSERDA Carbon Neutral Buildings Roadmap
SUNY Energy Efficiency Design Guide
Envision Framework

A.3 Zero Emissions

NYSERDA Clean Energy Standard (CES)
NYSERDA Renewables/Distributed Energy Resources
EPA Conducting Site and Economic Renewable Energy Project Feasibility Assessments
Better Buildings Solution Center OnSite Energy Storage Decision Guide
NYSDEC Value of Carbon Guidance
NYSERDA Carbon Neutral Buildings Roadmap
SUNY Energy Efficiency Design Guide
NYSERDA Charge Electric
Envision Framework

A.4 Design for Resilience

FEMA Flood Insurance Rate Maps
FEMA Region 2 Base Level Engineering Viewer
FEMA National Risk Index
NYS Climate Impacts Assessment
NYS Heat Vulnerability Maps
NOAA Atlas 14
Coastal New York Future Floodplain Mapper
ULI Developing Resilience Toolkit
NYC Climate Resiliency Guidelines
Climate Resilience Strategies for Buildings in New York State
EPA Conducting Site and Economic Renewable Energy Project Feasibility Assessments
EPA Stormwater Best Management Practice: Green Parking
EPA Stormwater Best Management Practice on Permeable Pavements
EPA Stormwater Best Management Practice: Bioretention
Enterprise Hazard Strategies Guide
EPA Using Cool Roofs to Reduce Heat Islands
Better Buildings Solution Center's OnSite Energy Storage Decision Guide
DEC Construction Stormwater Toolbox
Passive House retrofit standards
Part 502 – Floodplain Management Criteria for State Projects
Envision Framework
AIA Climate Change Adaptation and Design Resources

Appendix B: Stretch Energy Code Comparison [Commercial]

Link: https://www.nyserda.ny.gov/All-Programs/Clean-Resilient-Building-Codes/NYStretch-Energy-Code-2020/NYStretch-Adoption-Resources

Table B-1

II. Differences between NYStretch and ECCCNYS-2020: *Commercial Buildings*

Compliance Path Options:

Compliance Path	NYStretch	ECCCNYS-2020
ASHRAE Compliance Path	✓	✓
Prescriptive (including COM*check*)	✓	✓
Total Building Performance (C407)		✓

Comparison of residential NYStretch requirements that amend or add to the ECCCNYS-2020. This does not include corresponding amendments and additions to ASHRAE 90.1-2016:

Code Section	NYStretch	ECCCNYS-2020
Table C402.1.3 Opaque Thermal Envelope Insulation Component Minimum Requirements, R-value Method	Some values have changed. See comparison table below	See comparison table below
Table C402.1.4 Opaque Thermal Envelope Assembly Maximum Requirements, U-factor Method	Some values have changed. See comparison table below	See comparison table below
C402.1.4.2 Thermal Resistance of Mechanical Equipment Penetrations (Mandatory) [New Section]	Mechanical equipment penetrations exceeding 1% of the opaque above-grade wall area must be calculated as a separate wall assembly with default U-factor of 0.5	N/A
C402.2.8 Continuous Insulation (Mandatory) [New Section]	Structural elements of balconies and parapets that penetrate the building thermal envelope must be continuously insulated (R-3 minimum) or thermally broken (R-3 minimum)	N/A
Table C402.4 Building Envelope Fenestration Maximum U-factor and SHGC Requirements	Some values have changed. See comparison table below	See comparison table below
C402.5 Air Leakage—Thermal Envelope (Mandatory)/C402.5.9 Air Barrier Testing [New Section]	New buildings between 25,000 sq.ft. and 50,000 sq.ft. and ≤75' tall must be air barrier pressure tested in accordance with C402.5.9 of NYStretch. All other buildings have the option to comply with C402.5.1 through C402.5.8 and C408.4 [new commissioning requirement, see below]	All buildings have the option to comply with Sections C402.5.1 through C402.5.8 or by air barrier pressure testing
C403.7.4 Energy Recovery Ventilation Systems (Mandatory)	Exception where the largest source of air exhausted at a single location, or multiple locations within a 30' radius from the outdoor air supply unit, is <75% of designed outdoor air flow rate	Exception where the largest source of air exhausted at a single location is <75% of designed outdoor air flow rate
C403.8.1 Allowable Fan Horsepower (Mandatory)	New exception added for fans supplying air to active chilled beams	N/A
Table C403.8.1(1) Fan Power Limitation	Some values have changed. See comparison table below	See comparison table below
C405.2.1 Occupant Sensor Controls	Adds corridors/transition and dining areas to locations where occupancy sensors are required	N/A
C405.2.1.4 Occupant Sensor Control Function for Egress Illumination [New Section]	New buildings have automatic lighting reduction controls for exit access and egress lighting (exceptions apply)	N/A

Appendix C: Climate Change Projections Tables

Climate change projections for a variety of hazards by region, sourced from the 2024 [NYS Climate Impacts Assessment](). Like all projections, these climate projections have uncertainty embedded within them. Sources of uncertainty include data and modeling constraints, the random nature of some parts of the climate system, and limited understanding of some physical processes. Levels of uncertainty are characterized using state-of-the-art climate models, multiple scenarios of future greenhouse gas concentrations, and recent peer-reviewed literature. Even so, the projections are not true probabilities, so the specific numbers should not be emphasized, and the potential for error should be acknowledged. The below tables represent the 90th percentile climate projections of the unweighted combination of the results from SSP2-4.5 and SSP5-8.5 scenarios (consistent with the NYS Climate Impact Assessment).

Climate projections vary depending on the region. Project managers should use the regional projections corresponding to the project location.

Figure 1: Regional boundaries established through the NYS Climate Risk Assessment.

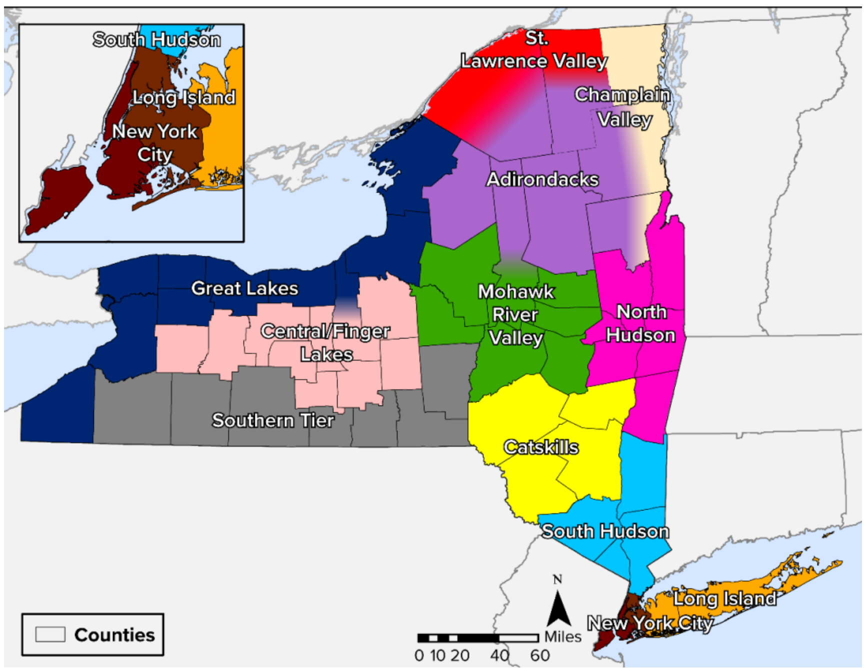


Table B-2. Sea Level Rise Projections

Sea Level Rise Projections by Station - 90th Percentile (inches)					
	2030s	2050s	2080s	2100	2150
Long Island	14	25	48	69	185
New York City	13	23	45	65	177
Albany	12	21	41	60	171

Table B-3. Climate Change Projections for Adirondacks Region (refer to map)

Adirondacks Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	2030s	2040s	2050s	2060s	2070s	2080s	2100
Change in Annual Mean Temperature (°F)	40.7	5.3	6.7	7.8	9.4	11	12.9	15.2
Days Over 90°F	1	20	25	32	37	52	72	N/A
Days Below 32°F	188	169	165	161	157	157	149	N/A
Annual Cooling Degree Days	182	610	715	855	1,028	1,241	1,541	N/A
Annual Heating Degree Days	8,602	6,888	6,504	6,212	5,730	5,253	4,822	N/A
Increase in Annual Mean Precipitation	41.5”	10%	12%	13%	15%	17%	18%	26%
Days Over 2" of Rain	0.8	1	1	1	1	2	2	N/A

Table B-4. Climate Change Projections for Adirondacks Region (refer to map)

Catskills Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	2030s	2040s	2050s	2060s	2070s	2080s	2100
Change in Annual Mean Temperature (°F)	48	5.1	6.3	7.4	8.7	10.4	12	14
Days Over 90°F	7	30	44	50	61	73	92	N/A
Days Below 32°F	124	108	104	101	101	101	97	N/A
Annual Cooling Degree Days	662	1,341	1,497	1,702	1,919	2,206	2,564	N/A
Annual Heating Degree Days	6,242	4,917	4,648	4,388	4,043	3,685	3,368	N/A
Increase in Annual Mean Precipitation	48.8”	10%	13%	14%	17%	19%	21%	27%
Days Over 2" of Rain	3	4	4	5	5	5	6	N/A

Table B-5. Climate Change Projections for Central Lakes Region (refer to map)

Central Lakes Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	47.7	5.1	6.4	7.4	9	10.7	12.3	14.3
Days Over 90°F	9	42	52	63	70	77	99	N/A
Days Below 32°F	134	118	118	114	110	110	106	N/A
Annual Cooling Degree Days	572	1,183	1,379	1,565	1,781	2,053	2,384	N/A
Annual Heating Degree Days	6,659	5,223	4,932	4,656	4,241	3,887	3,511	N/A
Increase in Annual Mean Precipitation	35.7”	9%	10%	11%	13%	14%	17%	22%
Days Over 2" of Rain	0.5	0.7	0.8	0.8	0.8	1	1	N/A

Table B-6. Climate Change Projections for Champlain Valley Region (refer to map)

Champlain Valley Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	42.8	5.4	6.9	8	9.6	11.1	13	15.3
Days Over 90°F	2	24	28	35	41	55	74	N/A
Days Below 32°F	158	144	144	136	136	132	132	N/A
Annual Cooling Degree Days	334	895	1,024	1,192	1,453	1,714	2,045	N/A
Annual Heating Degree Days	7,984	6,311	5,999	5,663	5,222	4,786	4,383	N/A
Increase in Annual Mean Precipitation	42”	11%	12%	14%	15%	18%	18%	26%
Days Over 2" of Rain	0.7	1	1	1	2	2	2	N/A

Table B-7. Climate Change Projections for Great Lakes Region (refer to map)

Great Lakes Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	47.8	5.2	6.4	7.4	9	10.7	12.4	14.5
Days Over 90°F	3	27	44	54	61	70	89	N/A
Days Below 32°F	126	110	110	102	102	99	99	N/A
Annual Cooling Degree Days	565	1,188	1,386	1,611	1,828	2,102	2,424	N/A
Annual Heating Degree Days	6,554	5,135	4,864	4,548	4,218	3,846	3,491	N/A
Increase in Annual Mean Precipitation	40.3”	8%	10%	11%	14%	15%	17%	23%
Days Over 2" of Rain	0.3	0.6	0.6	0.8	0.9	1	1	N/A

Table B-8. Climate Change Projections for Long Island Region (refer to map)

Long Island Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	51.1	4.6	5.5	6.7	8.3	9.8	11.3	13
Days Over 90°F	5	29	33	40	52	58	68	N/A
Days Below 32°F	107	91	87	83	83	80	76	N/A
Annual Cooling Degree Days	618	1,187	1,353	1,497	1,702	1,955	2,224	N/A
Annual Heating Degree Days	5,563	4,470	4,191	3,884	3,547	3,284	2,996	N/A
Increase in Annual Mean Precipitation	47.4”	10%	13%	14%	16%	18%	21%	30%
Days Over 2" of Rain	3	5	5	5	6	6	6	N/A

Table B-9. Climate Change Projections for Mohawk Valley Region (refer to map)

Mohawk Valley Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	42.6	5.3	6.6	7.7	9.3	10.8	12.6	14.6
Days Over 90°F	3	30	39	42	54	70	89	N/A
Days Below 32°F	160	143	135	135	135	135	127	N/A
Annual Cooling Degree Days	346	936	1,070	1,225	1,471	1,734	2,058	N/A
Annual Heating Degree Days	7,335	5,785	5,452	5,157	4,722	4,380	3,975	N/A
Increase in Annual Mean Precipitation	43.5”	9%	11%	13%	14%	15%	18%	22%
Days Over 2" of Rain	0.9	1	2	2	2	2	2	N/A

Table B-10. Climate Change Projections for New York City Region (refer to map)

New York City Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	55.2	4.7	5.9	7.1	8.6	10.2	11.6	13.5
Days Over 90°F	17	54	62	69	81	91	108	N/A
Days Below 32°F	70	58	52	52	52	50	48	N/A
Annual Cooling Degree Days	1,156	1,903	2,088	2,335	2,625	2,900	3,292	N/A
Annual Heating Degree Days	4,659	3,589	3,414	3,102	2,786	2,543	2,298	N/A
Increase in Annual Mean Precipitation	49.9”	10%	13%	14%	16%	19%	22%	30%
Days Over 2" of Rain	3	5	5	5	5	6	6	N/A

Table B-11. Climate Change Projections for North Hudson Valley Region (refer to map)

North Hudson Valley Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	47.8	5.3	6.6	7.7	9.3	10.8	12.6	14.7
Days Over 90°F	9	44	55	58	69	80	100	N/A
Days Below 32°F	140	124	121	117	117	117	110	N/A
Annual Cooling Degree Days	589	1,280	1,432	1,606	1,852	2,130	2,479	N/A
Annual Heating Degree Days	6,667	5,225	4,914	4,652	4,237	3,895	3,512	N/A
Increase in Annual Mean Precipitation	42.1”	10%	12%	13%	14%	16%	19%	25%
Days Over 2" of Rain	0.9	1	2	2	2	2	2	N/A

Table B-12. Climate Change Projections for South Hudson Valley Region (refer to map)

South Hudson River Valley Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	50.8	4.9	6.1	7.2	8.7	10.3	11.9	13.9
Days Over 90°F	18	57	64	73	80	94	108	N/A
Days Below 32°F	105	90	90	82	82	82	74	N/A
Annual Cooling Degree Days	903	1,596	1,762	1,992	2,266	2,528	2,889	N/A
Annual Heating Degree Days	5,181	4,052	3,869	3,533	3,187	2,913	2,642	N/A
Increase in Annual Mean Precipitation	45.8”	10%	13%	14%	17%	19%	22%	28%
Days Over 2" of Rain	3	5	5	5	6	6	6	N/A

Table B-13. Climate Change Projections for Southern Tier Region (refer to map)

Southern Tier Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	46.5	5.1	6.3	7.4	8.8	10.5	12.2	14.1
Days Over 90°F	3	23	29	35	45	55	73	N/A
Days Below 32°F	142	125	125	117	117	117	113	N/A
Annual Cooling Degree Days	415	980	1,130	1,313	1,542	1,810	2,119	N/A
Annual Heating Degree Days	7,106	5,657	5,394	5,075	4,666	4,315	3,972	N/A
Increase in Annual Mean Precipitation	39.1”	8%	10%	12%	13%	14%	17%	22%
Days Over 2" of Rain	0.8	1	1	1	1	2	2	N/A

Table B-14. Climate Change Projections for St Lawrence Valley Region (refer to map)

St Lawrence Valley Climate Change Projections - 90th Percentile								
	Baseline (1981-2010)	**2030s**	**2040s**	**2050s**	**2060s**	**2070s**	**2080s**	**2100**
Change in Annual Mean Temperature (°F)	44.3	5.2	6.6	7.8	9.5	11.1	13	15.2
Days Over 90°F	2	28	37	43	50	65	83	N/A
Days Below 32°F	163	147	144	140	140	140	140	N/A
Annual Cooling Degree Days	400	942	1,092	1,269	1,464	1,708	2,013	N/A
Annual Heating Degree Days	8,031	6,425	6,078	5,793	5,334	4,881	4,477	N/A
Increase in Annual Mean Precipitation	36.7”	9%	11%	14%	15%	15%	17%	24%
Days Over 2" of Rain	0.5	0.9	0.9	1	1	1	1	N/A